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# **Bass Lake Integrated Aquatic Vegetation Management Plan**

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December 2012



**King County**

Department of Natural Resources and Parks  
Water and Land Resources Division

**Science and Technical Support Section**

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# Bass Lake Integrated Aquatic Vegetation Management Plan

## Prepared for:

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Water Quality Program

## In fulfillment of grant #:

G1000537

## Submitted by:

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Department of Natural Resources and Parks



**King County**

Department of  
Natural Resources and Parks

**Water and Land Resources Division**

# Acknowledgements

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## Citation

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## EXECUTIVE SUMMARY

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Eurasian watermilfoil (*Myriophyllum spicatum*) is an invasive submersed aquatic weed that proliferates to form dense mats of vegetation in the littoral zone of lakes and reservoirs. It reproduces by fragmentation, and is often spread as fragments that “hitchhike” on boat trailers from one lake to another. *M. spicatum* can degrade the ecological integrity of a water body in just a few growing seasons. Dense stands of milfoil crowd out native aquatic vegetation, which in turn alters predator-prey relationships among fish and other aquatic animals. *M. spicatum* can reduce dissolved oxygen in two ways– first by inhibiting water mixing in areas where it grows, and second as oxygen is consumed by bacteria during decomposition of dead plant material. Decomposition of *M. spicatum* also adds nutrients to the water that could contribute to increased algal growth and related water quality problems. Further, dense mats of *M. spicatum* can increase the water temperature by absorbing sunlight, create mosquito breeding areas, and negatively affect recreational activities such as swimming, fishing, and boating. The State of Washington has designated Eurasian watermilfoil as a Class B noxious weed that is mandated for control, although King County has named it as a “Weed of Concern.”

Bass Lake, located in the Green River watershed in King County, Washington, is moderately infested with *M. spicatum*. It was identified in the lake by King County Metro as early as 1976 and has been present in subsequent surveys, the most recent one done in August of 2012.

In addition to Eurasian milfoil, four other invasive plants were identified by King County Water and Land Resources staff in 2011 and 2012 at or in close proximity to Bass Lake. Both purple loosestrife (*Lythrum salicaria*) and reed canary grass (*Phalaris arundinacea*) have been identified along the lakeshore, and while the reed canary grass is quickly growing beyond pioneering infestation, the purple loosestrife is at a level that can easily be controlled if actions are taken quickly. Japanese knotweed (*Polygonum cuspidatum*) has been found within the immediate vicinity of the lake shoreline. Japanese knotweed is in the parking area of the boat launch on a few feet away from the lake. Sulfur cinquefoil (*Potentilla recta*) has been found 0.2 miles from the lake shoreline and only 200 hundred feet from the fen that borders the lake. Sulfur cinquefoil is not an aquatic invasive plant; however, it is thought to be capable of colonizing aquatic areas. While it is not an immediate threat to the lake shoreline similar to milfoil and purple loosestrife, it will be important to track and map the infestation carefully to prevent spreading to the Bass Lake shoreline. Immediate control measures will help prevent these invasive weeds from spreading to Bass Lake and into the adjoining park and natural lands.

This *Integrated Aquatic Vegetation Management Plan* (IAVMP) is a planning document developed to ensure that the community has considered the best available information about the water body and the watershed prior to initiating any control efforts. Members of the Bass Lake community, Middle Green River Coalition and King County staff worked in partnership to develop this IAVMP for Bass Lake. From these groups, a steering committee was formed to direct and guide the IAVMP process that represents the diverse opinions of

the stakeholders. Through their work, the Steering Committee educates the wider community about the problem, inspires them to contribute feedback about potential treatment options, and explores ongoing community-based funding mechanisms. This plan presents lake and watershed characteristics, details of the aquatic weed problems at Bass Lake, outlines the process for gaining community involvement, discusses control alternatives, and recommends initial and ongoing control strategies for noxious aquatic weeds threatening Bass Lake.

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## 1.0. LOCATION

Bass Lake is 2.5 miles southeast of the city of Black Diamond and 3.5 miles north of the city of Enumclaw. The lake is just south of the Green River and is in Water Resources Inventory Area 9 (WRIA 9), also known as the Green-Duwamish River Watershed (Figure 1).

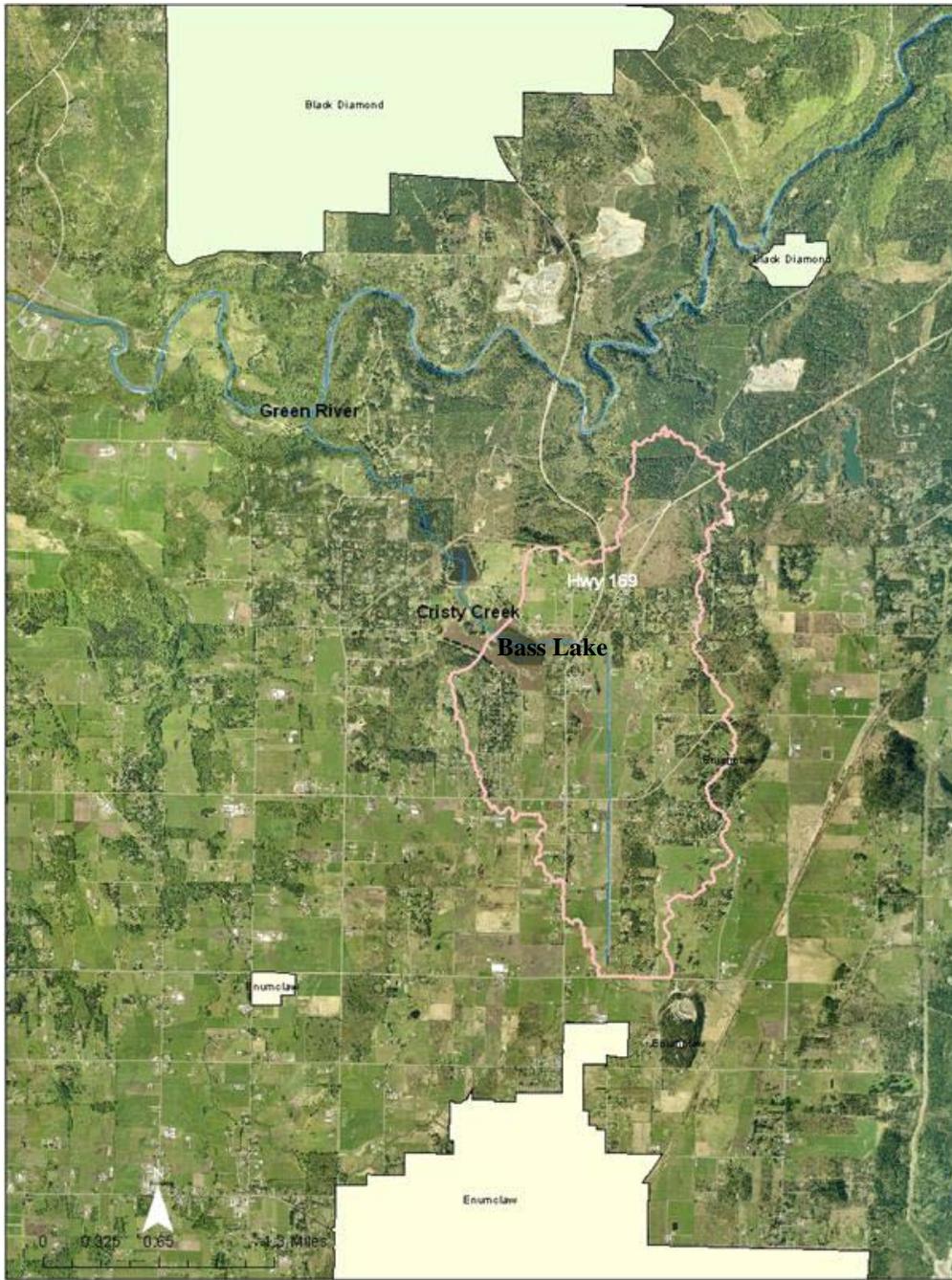


Figure 1. Bass Lake in relation to neighboring cities

A large portion of the property around Bass Lake is public land owned by King County Department of Natural Resources and Parks (DNRP), with a boat launch owned by the Washington Department of Fish and Wildlife. There are three private property owners along the shoreline of Bass Lake (Figure 2).

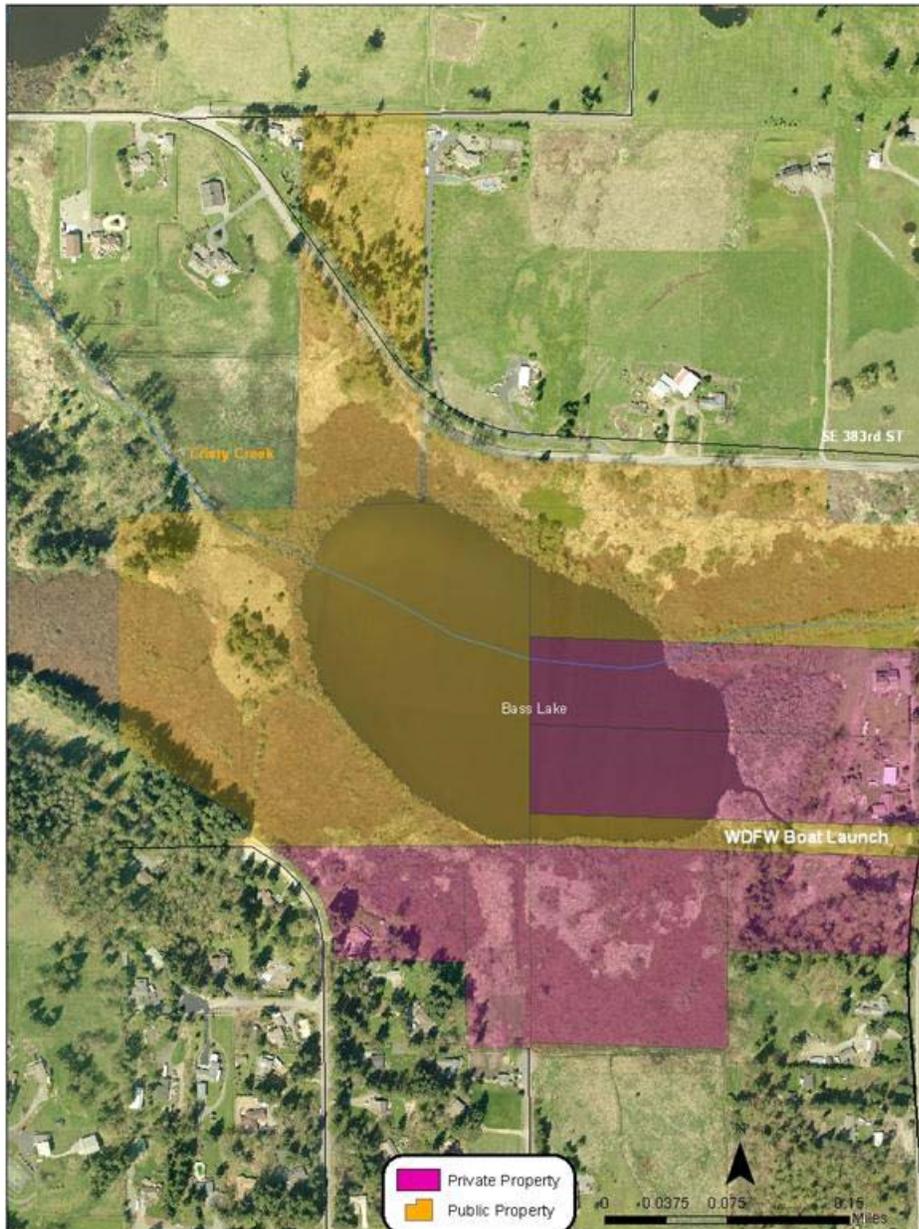


Figure 2. Property ownership around Bass Lake

The lake is included within the Bass Lake Natural Area, which is managed by the King County Natural Lands Program in the Parks Division. Three lakes are within this natural area, forming a lake complex: Bass (24 acres), Beaver (12 acres), and Dandy (6 acres) (Figure 3). These lakes provide habitat for aquatic animals, many bird species, and other animals that use the lake and complex for shelter and foraging. Bass Lake and the surrounding properties have been identified by King County as possessing diverse native vegetation that provides important fish and wildlife habitat and complex aquatic elements, such as open water, wetlands, and streams. The lake also provides recreational opportunities for anglers. Due to the preponderance of wetlands adjacent to the lake, there is very limited development potential along its shoreline.

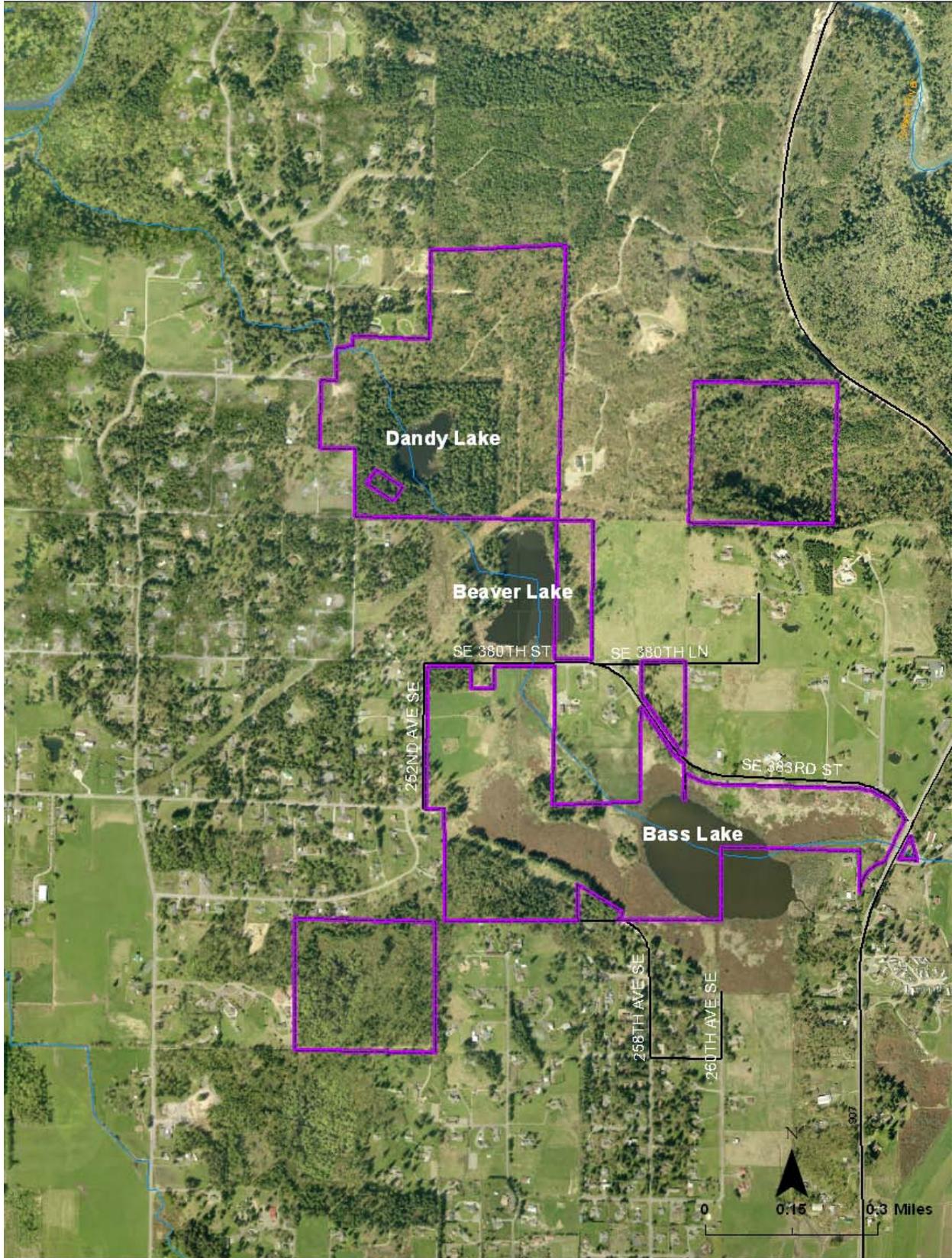


Figure 3. The 3 lake complex in the Bass Lake Natural Area Boundary

## 2.0. PROBLEM STATEMENT

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Due to increases in several species of invasive noxious weeds, Bass Lake is in danger of losing wildlife habitat, recreational benefit, and aesthetic value. If left untreated, Eurasian watermilfoil could blanket the lake in a short time, limiting many recreational uses and eliminating important aquatic habitat. The invasive shoreline plants threaten to turn the diverse shoreline habitat of Bass Lake into monoculture stands, reducing wildlife habitat availability that native plants provide and creating a significant threat to the surrounding natural lands that King County is preserving for the diverse ecological functions and healthy populations of native plants.

These invasive plants:

- Pose a safety hazard to boaters by entanglement of boating equipment;
- Snag fishing lines and hooks;
- Crowd out native plants, creating monocultures lacking in biodiversity;
- Significantly degrade fish and wildlife habitat, which will potentially reduce fish and wildlife populations;
- Reduce wildlife viewing opportunities; and
- Pose a threat to adjoining ecosystems.

Milfoil is the most significant submersed invasive threat to the lake, but other noxious weeds have been identified along the shoreline of Bass Lake. Purple loosestrife has a pioneering population along the shoreline, and Japanese knotweed, reed canary grass and sulfur cinquefoil have been found upland of Bass Lake. All of these invasive weeds have the ability to spread rapidly and out-compete native plants, damaging the ecological functions of the surrounding habitat.

However, Eurasian milfoil and purple loosestrife are the only two noxious weeds present at the lake that qualify as aquatic invasive weeds. While Japanese knotweed, reed canary grass, and sulfur cinquefoil are definitely invasive, they are not specifically aquatic weeds and on their own would not qualify for control funding through the aquatic weed program at the Washington State Department of Ecology (Ecology). Japanese knotweed, sulfur cinquefoil, and reed canary grass are included in this document as reference so any group that chooses to work on the invasive weeds around Bass Lake has a comprehensive reference document in this IAVMP.

## 3.0. MANAGEMENT GOALS

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Bass Lake, located within the King County Bass Lake Natural Area, has management goals already in place, as directed by the DNRP. The management goals include conservation and enhancement of the ecological values of the property.

The DNRP has invested resources in this complex to ensure that the habitat is maintained and managed for the highest and best use for wildlife and ecological processes. Invasive weeds threaten the ecological function of the complex, and the DNRP has prioritized controlling the noxious weeds and strive for eradication where appropriate.

The goals set forward by the King County Parks Division (Natural Lands Program) for Bass Lake are complemented by aquatic weed management goals, which are to control noxious aquatic weeds in Bass Lake in a manner that allows sustainable native plant and animal communities to thrive, maintains acceptable water quality conditions, and facilitates recreational enjoyment of the lake.

The main strategies to ensure success in meeting these goals are:

1. Involve local community groups, nearby residents and adjacent landowners in each stage of the process;
2. Use the best available science to identify and understand likely effects of management actions on aquatic and terrestrial ecosystems prior to implementation;
3. Review the effectiveness of management actions through monitoring; and
4. Adjust the management strategy as necessary to achieve the overall goal.

Detailed treatment prescriptions for each of the noxious weeds that encompass these management goals are covered in subsequent sections of this plan.

## 4.0. COMMUNITY INVOLVEMENT

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### 4.1 Steering Committee, outreach, and education process

King County DNRP has two divisions working in the Bass Lake Natural Area: the Parks Division (Parks) and the Water and Land Resources Division (WLR). Parks manages county land in the natural area via the Natural Lands Program, which includes monitoring, securing, and restoring the properties. WLR works to acquire lands for preservation near the lakes, tracks noxious weed infestations within the county, and implements habitat restoration projects. The Science section of WLR has conducted several aquatic noxious weed surveys at Bass Lake over the course of several years to track weed populations and infestations.

The WLR science section initiated the Integrated Aquatic Vegetation Management Plan (IAVMP) process to ensure there was a cohesive and thorough plan to guide noxious weed management decisions. Science section staff coordinates this effort with staff from both DNRP divisions.

In the spring of 2010, WLRD science section staff applied for and was granted a Washington State Department of Ecology (WDOE) aquatic weed fund grant to work on the development and writing of an IAVMP. In the summer of 2010 WLR staff began reaching out to the Bass Lake community by sending postcards to residents within a half mile of the lake, inviting individuals to attend a meeting to hear more about the project and being a part of the project steering committee.

#### October 2010: First Public Meeting

Beth leDoux from King County met with interested residents at an introductory meeting for the IAVMP process, including the development of a Steering Committee. Representatives from the King County Natural Lands group, King County Noxious Weed Group and King County WLR were in attendance along with one community member, Bernie McKinney, who is also the Bass Lake Natural Area Community Parks Ambassador. Mr. McKinney agreed to be a part of the steering committee.

#### February 2011: Meeting with Middle Green River Coalition (MGRC)

Sally Abella from WLR went to present the project to the MGRC in March 2011. Ten people attended and three people from the Coalition agreed to take part in the Steering Committee.

#### October 2011: Meeting with Steering Committee

On October 3, the Steering Committee met to talk about next steps and actions. At this meeting the pattern of the milfoil density was discussed, and the committee felt very strongly that the project should be extended into 2012 so that the lake could be surveyed

one more time before preferred actions were set for the final management plan. At that time, the idea of adding Japanese knotweed and reed canary grass to the plan was included to make sure that all invasive weeds were discussed, allowing for educated management decisions if the community chooses to take action on these weeds.

## 4.2 Continuing Community Education

To ensure that community efforts are consistent with best available science and water quality standards, information will be disseminated through MGRC meetings, and watershed mailings when applicable. The steering committee will be able to act as liaisons between community members and King County DNRP.

## 5.0. WATERSHED AND WATERBODY CHARACTERISTICS

Bass Lake is 24 acres in surface area, with a maximum depth of 12.1 meters. The surrounding watershed is approximately 257 acres and is dominated by soils typical of the glacial till that occurs in this region. Alderwood soils, which are moderately deep and moderately drained, dominate the soil types in the area of the lake complex. (Figure 4)



AgB	Alderwood gravelly sandy loam, 0 to 6 percent slopes
AgC	Alderwood gravelly sandy loam, 6 to 15 percent slopes
AgD	Alderwood gravelly sandy loam, 15 to 30 percent slopes
AKF	Alderwood and Kitsap soils, very steep
BeC	Beausite gravelly sandy loam, 6 to 15 percent slopes
Bu	Buckley silt loam
EvC	Everett gravelly sandy loam, 5 to 15 percent slopes
KpB	Kitsap silt loam, 2 to 8 percent slopes
RaC	Ragnar fine sandy loam, 6 to 15 percent slopes
Sk	Seattle muck
Sm	Shalcar muck
Tu	Tukwila muck
W	Water

Figure 4. Soils map of the Bass Lake Complex

A stream, Cristy Creek, drains Bass Lake to Beaver and Dandy Lakes, after Dandy Lake, the stream goes underground and becomes subsurface flow until it eventually daylight at Flaming Geyser State Park and flows to the Green River (Figure 3) (King County, 2009). Cristy Creek is a small stream making boating between the lakes very difficult. However, the creek supports several fish species including cutthroat and rainbow trout. The lower mile of Cristy Creek support chum, coho, cutthroat and steelhead. The lakes also support warm water fish species such as largemouth bass.

## 5.1 Fish and Wildlife Communities of Bass Lake

### 5.1.1 Fish

Although Bass Lake was supplied with fish by the Washington Department of Fish and Wildlife for many years, it has not been stocked in 15-20 years (D. Garrett, pers. comm.) and no private group has taken over stocking the lake with game fish. However, it is likely that there are non-native, warm water fish in the lake, including species such as Largemouth Bass, Black Crappie, Yellow Perch and Pumpkinseed (MGRC website).

### 5.1.2 Birds, Invertebrates and Mammals

Bass Lake is surrounded by one of the largest wetland areas in King County. This wetland complex is important for native frogs and salamanders, and also provides habitat for an extensive and diverse bird population, including bald eagles, pileated woodpeckers, wood ducks, buffleheads, great blue herons, ospreys, and kingfishers. The mammals in the watershed include elk, black bear, deer, cougar, mink, and river otter.

### 5.1.3 Water Quality

There are no known water quality data for Bass Lake and at this time, there are no plans to implement a program.

### 5.1.4 Beneficial and Recreational Uses

Bass Lake provides several opportunities for passive recreation, including fishing, canoeing and birding. Hiking trails and birding platforms may be added to the Bass Lake Natural Area at some point in the future. There are several abandoned hunting blinds along the lakeshore, but most are in poor condition.

### 5.1.5 Characterization of Aquatic Plants in Bass Lake

Several aquatic plant surveys have been done at Bass Lake since the 1970s. Table 1 below summarizes the plants found at the lake throughout the last three decades. However, this table should not be considered a comprehensive list of every plant present. These surveys were done while surveying for Eurasian milfoil and include common species noticed at the same time. If a plant other than Eurasian milfoil is listed as present one year, but not in the next, it cannot be taken as a record of absence in the plant community. However, the 2011

survey was the first time that purple loosestrife was documented, found in two places along the lake shore. Because it is an invasive species that has been the focal point of many surveys, it would be likely to be noted if it had been present during the previous surveys.

Table 1. List of plants present during milfoil surveys over the last three decades

	1977	1978	1980	1995	2007	2009	2010	2011	2012
<i>Brasenia schreberi</i>	x	x	x	x	x	x	x	x	x
<i>Carex sp</i>				x	x				
<i>Chara</i>								x	x
<i>Ceratophyllum demersum</i>	x	x	x	x		x		x	x
<i>Elodea canadensis</i>				x	x	x	x	x	x
<i>Hydrocotyle sp.</i>				x					
<i>Juncus sp.</i>				x	x				
<i>Ludwigia palustris</i>				x					
<i>Lythrum salicaria</i>								x	x
<i>Myriophyllum sp.</i>				x			x	x	x
<i>Myriophyllum spicatum</i>	x	x	x	x	x		x	x	x
<i>Najas flexilis</i>		x	x						
<i>Nitella sp.</i>			x						
<i>Nuphar lutea</i>				x	x	x			
<i>Nuphar polysepala</i>						x	x		
<i>Nuphar variegatum</i>	x		x						
<i>Nymphaea odorata</i>	x		x						
<i>Polygonum sp.</i>				x					
<i>Potamogeton sp.</i>					x		x		
<i>Potamogeton amplifolius</i>	x	x	x	x	x	x		x	x
<i>Potamogeton berchtoldii</i>	x	x	x						
<i>Potamogeton zosteriformis</i>	x	x	x	x	x	x			
<i>Potentilla palustris</i>				x	x	x			
<i>Spiraea douglasii</i>				x	x				
<i>Spirodela polyrhiza</i>	x								
<i>Typha latifolia</i>	x			x	x	x			
<i>Utricularia vulgaris</i>	x	x	x	x	x	x	x		

## 6.0. NOXIOUS AQUATIC WEEDS IN BASS LAKE

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### 6.1 Eurasian watermilfoil (*Myriophyllum spicatum*)

Eurasian watermilfoil is a Class B noxious weed in the State of Washington; however, it listed as a weed of concern in King County and therefore is not mandated for control.

Eurasian watermilfoil is native to Europe, Asia, and North Africa and also occurs in Greenland (Washington State Noxious Weed Control Board, 1995). The oldest record of Eurasian watermilfoil in Washington is from a 1965 herbarium specimen collected from Lake Meridian, King County. It was first identified in the 1970s in Lake Washington.

Eurasian watermilfoil is among the worst aquatic pests in North America. *M. spicatum* is a submersed, perennial aquatic plant with feather-like leaves that forms dense mats of vegetation just below the water surface. Each leaf has 12 to 16 leaflets (usually more than 14), with the leaves arranged in whorls of 4 around the stem. Leaves near the surface may be reddish or brown, becoming green in deeper water. In western Washington, Eurasian watermilfoil frequently over-winters, and can maintain a considerable biomass (K. Hamel, pers. comm.). Sometimes during the summers there are emergent flower stalks that have tiny leaves. In the late summer and fall, the plants break into fragments that float with the currents, infesting new areas. Disturbed plants may also produce fragments at other times of the year that can produce new plants. *M. spicatum* was not previously thought to reproduce from seed in this region. However, aquatic plant experts are beginning to think that milfoil seeds might be playing a bigger role in repopulating lakes than was previously thought (K. Hamel, pers. comm.). Milfoil starts spring growth earlier than most native aquatic plants, and thereby gets a “head start” on other plants each season. Eurasian watermilfoil has been known to degrade the ecological integrity of a water body in just a few growing seasons.

Dense stands of milfoil crowd out native aquatic vegetation, which can alter predator-prey relationships by changing visibility and possible refugia for fish and other aquatic animals. Eurasian watermilfoil can also reduce dissolved oxygen – first by inhibiting water mixing in areas where it grows, and then directly as oxygen is consumed by bacteria during decomposition of dead plant material. Decomposition of *M. spicatum* also releases phosphorus and nitrogen to the water that could increase algal production. Further, dense mats of Eurasian watermilfoil can increase water temperature by absorbing sunlight, raise the pH of the water, and create mosquito breeding areas.

Eurasian watermilfoil will negatively affect recreational activities such as swimming, fishing, and boating. The dense beds of vegetation make swimming dangerous, snag fish hooks on every cast, and inhibit boating by entangling propellers or paddles and slowing the movement of boats across the water.

One of the first survey reports for Bass Lake is from August of 1976, and at that time *Myriophyllum* sp. was identified, but it was not specified to be *M. spicatum*. Several native plant species were identified in that survey, but there was no distinction as to whether the *Myriophyllum* found was native or non-native.

In August 1977, *Myriophyllum spicatum* was specifically identified, and the report noted that there was a drastic reduction in plant growth since the 1976 survey. The cause of the plant reduction was unknown and the milfoil was described as bare and black, with very few green leaves. The report noted it looked like herbicide damage, but there was no way to verify the impression. Another noxious weed identified in this survey was fragrant water lily (*Nymphaea odorata*).

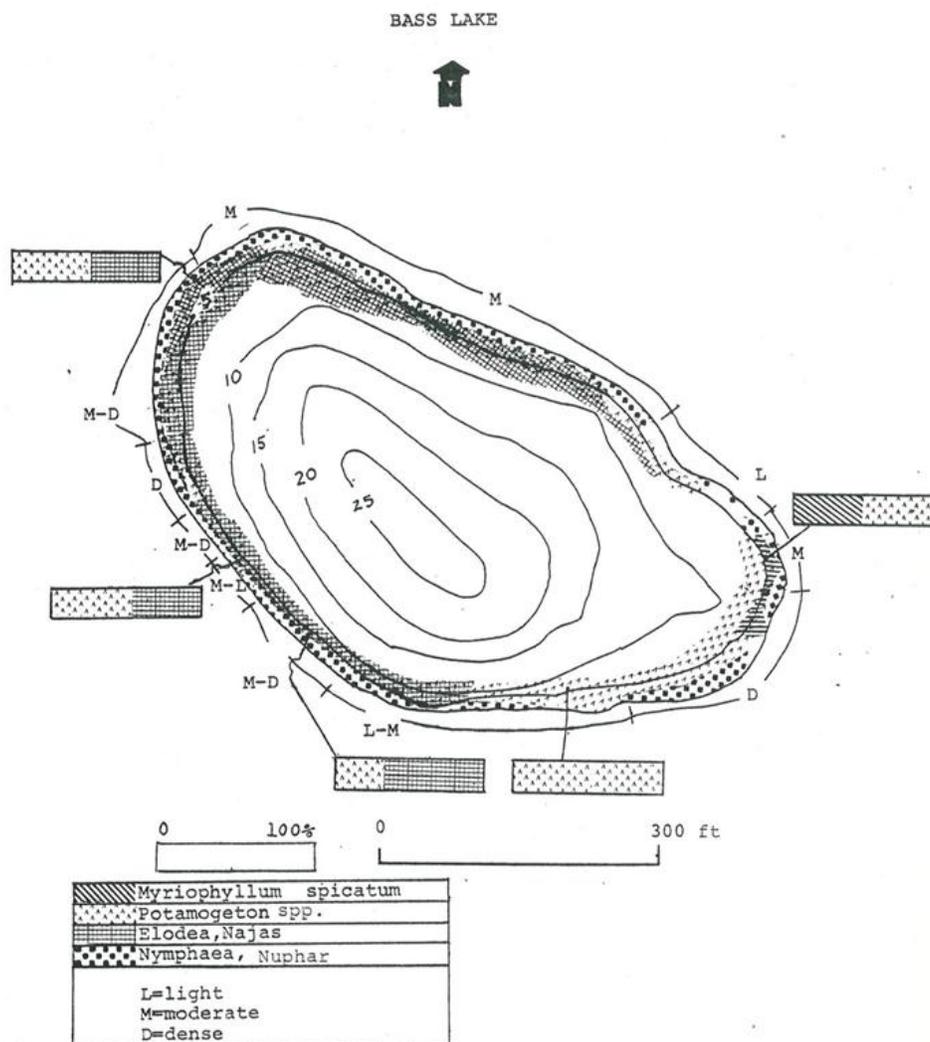


Figure 5. 1978 Contour Map showing density and areal distributions of macrophytes in Bass Lake

Bass Lake was surveyed again in August of 1978, and *M. spicatum* was found in a very small area (0.2 acres) in the NE corner compared to the 10.4 acres of unspecified milfoil found in 1976. Also noted was that the fragrant water lily density had dropped as well. The surveying agency, The Municipality of Metropolitan Seattle (METRO), concluded that there must have been some other reason aside from herbicide that caused the Eurasian milfoil to disappear. There was no evidence for any formal milfoil control program, so it was speculated that somehow natural events were causing the fluctuation in milfoil populations.

A survey was performed again by METRO in 1980, during which it was found that Eurasian milfoil was the most abundant and dominant species in Bass Lake. Fragrant water lily was still present as well.

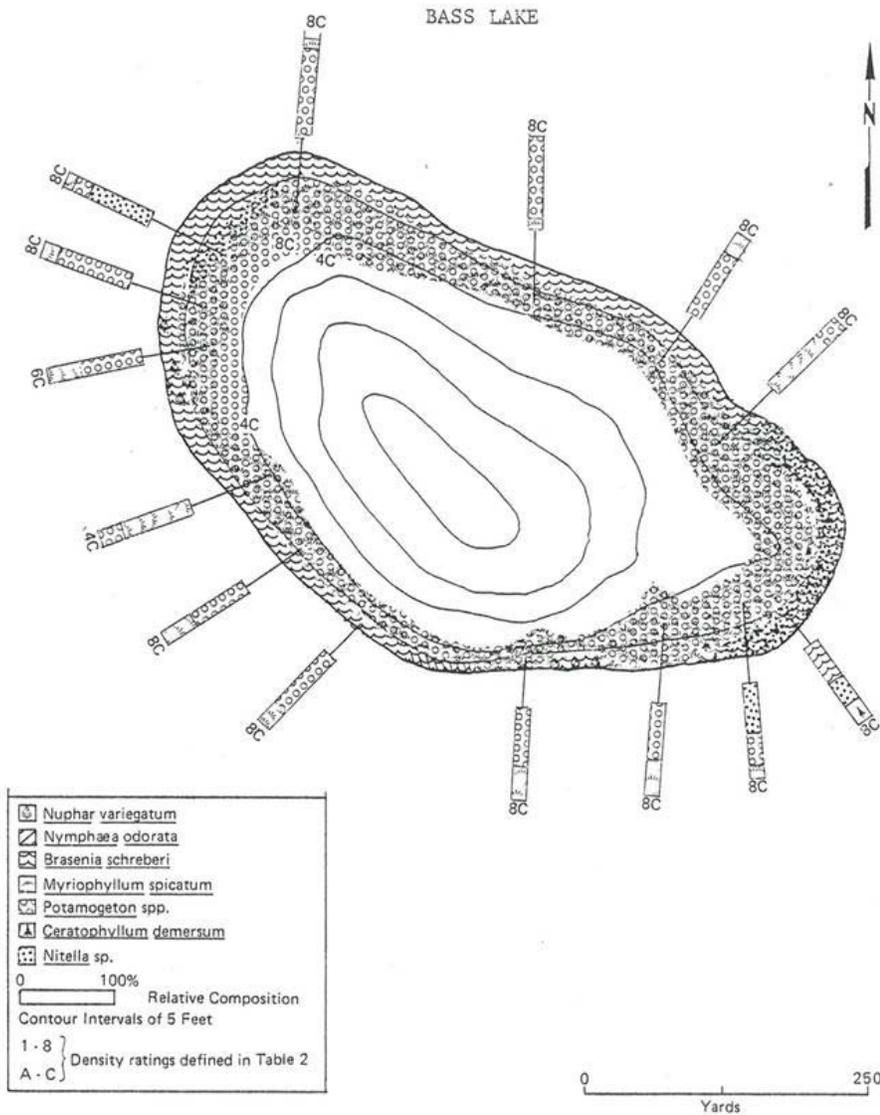


Figure 6. 1980 Contour Map showing density and areal distributions of macrophytes in Bass Lake

Bass lake was not surveyed again until 1995, when Eurasian watermilfoil was again seen as the dominant species. The report noted that at this time Eurasian milfoil was no longer mixed with potamogetons as in the previous surveys, suggesting more of a monoculture had been established. This was the earliest survey in which both Eurasian watermilfoil and *Myriophyllum sp.* were listed separately, suggesting this could have been the first survey in which native milfoils may have been differentiated.

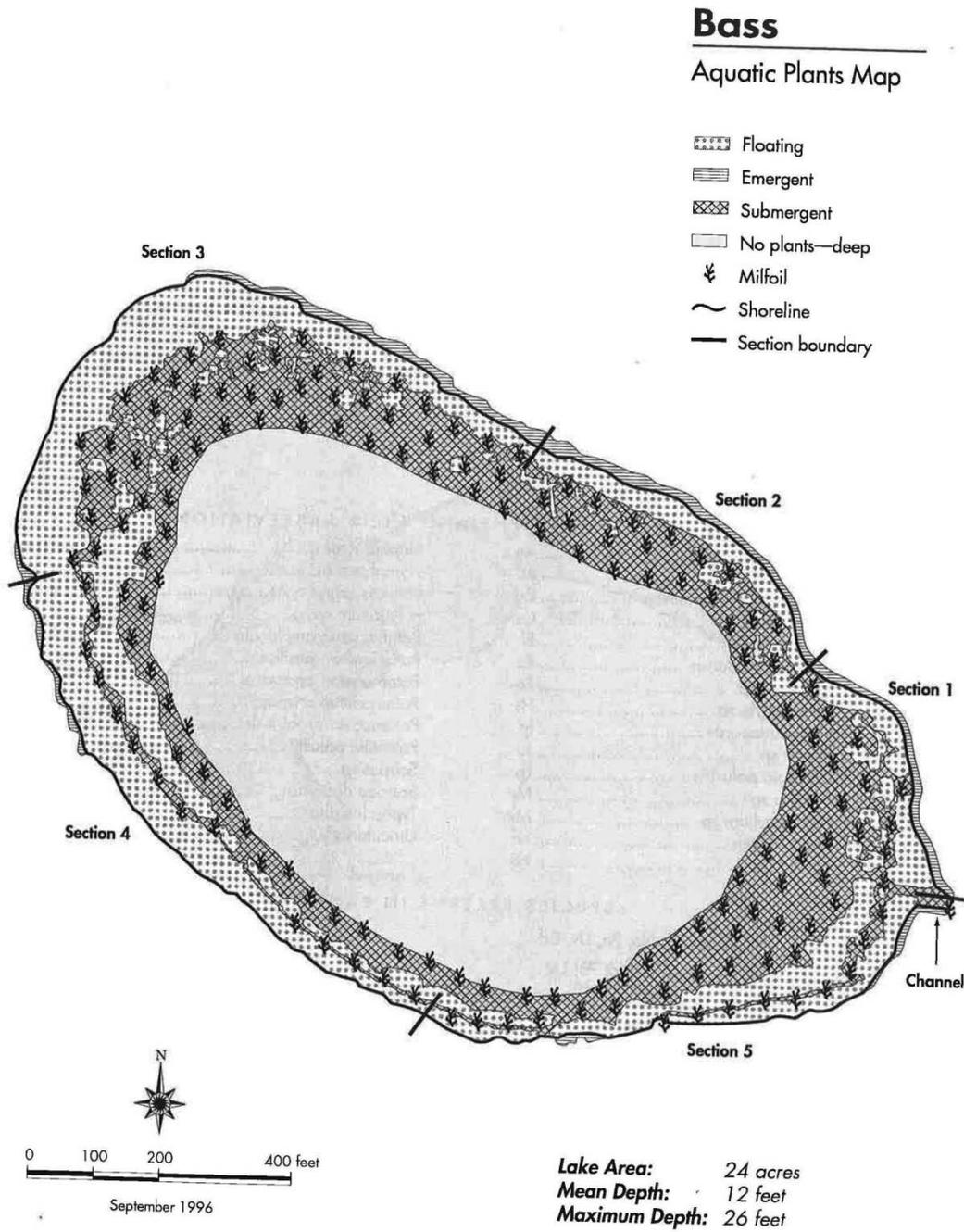


Figure 7. 1995 Map showing density and aerial distributions of macrophytes in Bass Lake

Further surveys were done in 1999 and again in 2001. Eurasian watermilfoil was identified in large densities in both efforts. There was no mention of native milfoil, which makes it

possible, based on the earlier surveys, that some native milfoils may have been misidentified as Eurasian watermilfoil.

King County WLR staff surveyed Bass Lake in 2007 and again in 2010 (Figure 8), finding large numbers of Eurasian watermilfoil on both occasions. However, in 2011, much like in 1977 there was a significant decrease in the density of the invasive milfoil (Figure 9). Only one plant was positively identified in the lake. Again, there was no evidence of herbicide application and it appeared that natural factors were at work. Also, it seems that fragrant water lily has disappeared from the lake and the floating plants present are *Brasenia schreberi* (watershield) and *Nuphar polysepala* (Yellow pond lily).

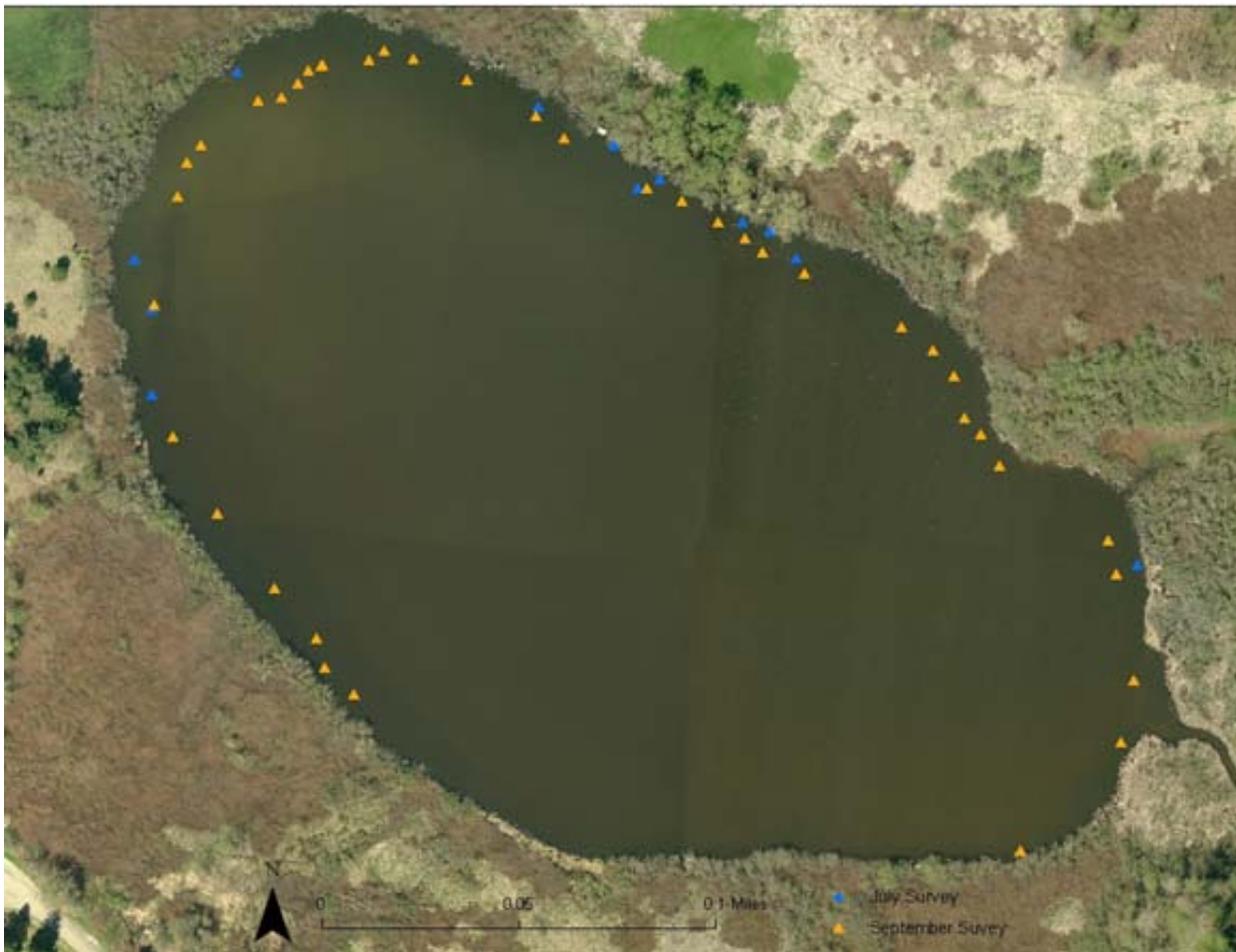


Figure 8. Eurasian milfoil locations in 2010 July and September surveys



Figure 9. Milfoil and Purple loosestrife locations in September 2011

Due to the milfoil population fluctuations found in the lake, the IAVMP Bass Lake Steering Committee asked to resurvey the lake in 2012 to determine if the milfoil was still present as a small population or if the population had increased in order to inform management recommendations.



Figure 10. Milfoil and Purple loosestrife locations in August 2012

In 2012 King County WLR staff surveyed the lake in August with the anticipation of that time being the peak of the growing season when the heaviest infestation of Eurasian milfoil would be present. The survey revealed that the native milfoil was in fact the most populous plant in the lake. Minor amounts of Eurasian milfoil were found in the lake near the boat launch, almost at the pioneering infestation level. The native milfoil was robust and made dense populations throughout the lake (Figure 10). Fragrant waterlily was not identified to be in the lake during this survey.

The apparent fluctuation of the Eurasian milfoil suggests that natural factors may be able to control its spread. However, a rigorous survey plan over time will need to be designed to insure the population does not suddenly increase without detection.

Two important things to note from the survey is that the native milfoil was not mapped, it was abundant throughout the littoral zone of the lake and that the presumed native milfoil was not sent for DNA identification to see if it is actually a hybrid species. In future surveys those will be two things that should be done.

## 6.2 *Lythrum salicaria* (purple loosestrife)

Purple loosestrife is a Class B weed in King County, and control is required.

It is native to Europe and Asia and was introduced through ship ballast water to the Atlantic Coast in the mid-1800s (Washington State Noxious Weed Control Board, 1997). In Washington, purple loosestrife was first collected from the Seattle area in 1929 from Lake Washington. This plant is a perennial that can reach 9 feet tall with long spikes of magenta flowers. The flowers usually have 6 petals, and the stems are square. Purple loosestrife is considered a facultative wetland species with a 67-99% probability of occurring in wetlands as opposed to upland areas (Reed, 1988). Vigorous plants can produce over 2 million tiny, lightweight seeds (120,000 per spike) that are easily spread by waterfowl and other animals (Washington State Noxious Weed Control Board, 1997). Although a prolific seeder, purple loosestrife can also spread through vegetative production by shoots and rhizomes as well as by root fragmentation. It has a woody taproot with a fibrous root system that forms a dense mat, keeping other plants from establishing.

Purple loosestrife disrupts wetland ecosystems by displacing native or beneficial plants. Loss of native vegetation results in decreased sources of food, nesting material, and shelter and in fact, waterfowl, fur-bearing animals, and birds vacate wetland habitat when native vegetation is displaced by purple loosestrife. Economic impacts are high in agricultural communities when irrigation systems are clogged or when wet pastures are turned into a monoculture and are unavailable for grazing.

Purple loosestrife is aggressive and competitive, taking full advantage of disturbance to natural wetland vegetation caused by anthropogenic alterations of the landscape. Seed banks can build up since seeds may remain viable for up to 3 years. Monospecific stands are long-lived in North America as compared to European stands, illustrating the competitive edge loosestrife has over native plant species.

Two large plants were found in August of 2011 and 2012 (Figure 9 & 10) on the shoreline of Bass Lake. The seed heads were clipped in 2011, and in 2012 the identified plants were pulled out by hand, including the majority of the root wads. However, the areas with loosestrife may continue to be a nuisance until a more thorough eradication plan is followed. Future surveys and management action will be necessary to follow up the discovery and try to prevent further infestation. *Polygonum cuspidatum* (Japanese knotweed)

## 6.3 *Polygonum cuspidatum* (Japanese knotweed)

Japanese knotweed is a Class C weed, a non-regulated noxious weed that is recommended for control but not required because of its wide distribution in King County.

*P. cuspidatum* is a perennial species that can quickly invade and take over riparian habitats. It is a native of Japan, but was introduced into the United States as an ornamental in the late 1800s and has since escaped from residential gardens. Knotweed is found all over

North America and is increasingly common around stream corridors, rights-of-way, and lake shorelines.

Japanese knotweed is difficult to control due to its vigorous rhizomes that form deep, dense underground mats. It can reach from four to eight feet tall and be densely shrubby. The plant can reproduce by seed, rhizomes and most commonly, from fragments. When pieces of the plant fall into a water body, it can colonize elsewhere along the shoreline.

Thickets of the invasive weeds can clog small waterways, reduce available habitat for fish and wildlife, and cause erosion problems when it dies back in fall and leaves the ground exposed to the weather during the winter.

The population found at Bass Lake is just a little landward on the WDFW boat launch, and is also on the bordering private property to the southeast.

## 6.4 *Phalaris arundinacea* (reed canary grass)

*Phalaris arundinacea* (reed canary grass)

Reed canary grass is very common throughout King County and is a Class C weed, recommended for control but not mandated.

It is a perennial grass species that can quickly form dense, monocultural stands that present an extreme threat to the integrity of wetland and other aquatic ecosystems. Some forms of the species are likely native to North America, but European cultivars have been introduced for hay and forage, and they are very hard to differentiate. Reed canary grass spreads through seeds and creeping rhizomes, flowering in Washington from June through August. Dense stands of this grass have very little food value for wildlife and stems grow too densely to provide cover for small mammals and waterfowl. The grass also can slow water flow in ditches and streams, leading to increased siltation.

Reed canary grass is found in small amounts along the Bass Lake shoreline. However, it is found in larger densities throughout the fen attached to Bass Lake and surrounding Bass Lake complex.

## 6.5 *Potentilla recta* (sulfur cinquefoil)

Sulfur cinquefoil is a Class B noxious weed in King County and control is required.

Originally from the eastern Mediterranean region, it was first found in Washington State in 1937. It spreads by seeds and also reproduces vegetatively via new shoots. Sulfur cinquefoil starts to grow in early spring, flowering from May through July. The cinquefoil is a perennial, and seed is set in late summer, but the plant can continue to grow until the first frost. The plant can self-pollinate, and the seedlings quickly mature into flowering plants (King County Noxious Weed website, 2012).

Sulfur cinquefoil invades pastures, grass fields or shrub-dominated areas. In King County the plant typically is found in rocky soils and seasonally wet meadows. Currently, an infestation has been located in the upper pastureland west of Bass Lake, on King County Natural Lands property, making it possible for the plant to invade the surrounding fen and shoreline. While the plant has not yet been found at the shoreline or in the fen as of yet, it will be important to track this plant and have a control plan ready should it spread.

## 7.0. AQUATIC PLANT CONTROL ALTERNATIVES

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This section outlines common methods used to control aquatic weeds. Much of the information in this section is quoted directly from the Washington State Department of Ecology's website:

<http://www.ecy.wa.gov/programs/wq/plants/management/index.html>

Additional information is derived from the field experience of the King County Noxious Weed Control Program and the King County Lake Stewardship Program. Recommendations found in the 2001 draft version of the "King County Regional Milfoil Plan" have also been taken into consideration.

Control/eradication methods discussed herein include Aquatic Herbicide, Manual Methods, Bottom Screens, Diver Dredging, Biological Control, Cutting, and Harvesting.

broad control method category	Specific method	compatible with Bass Lake water body characteristics	effectiveness for purple loosestrife	further consideration?	effectiveness for Eurasian watermilfoil	further consideration?	effectiveness for knotweed	further consideration?	effectiveness for reed canary grass	further consideration?	effectiveness for sulfur cinquefoil	further consideration?
Manual and Environmental Manipulation Control Methods	Hand pulling	yes	effective in some situations, can be part of an IPM solution	YES*	Water too dark to ensure the whole plant is removed	no	not practical - cannot get all rhizomes	no*	not practical - cannot get all rhizomes	no*	Can work in small areas of infestation	YES*
	diver hand pulling	no	NA	no	not practical for control as water color is very dark, plants may be missed, hazards for divers may be obscured and it will likely cause fragmentation	no	NA	no	NA	no	NA	no
	raking	yes	NA	no	not practical, causes fragmentation	no	NA	no	NA	no	NA	no
	bottom barriers/ weed mats	possible	can suppress growth in some situations, but will not eradicate. Infestation is small so other methods more effective	no*	not practical for a large area, can be useful for small areas of infestation. Maintenance issues make it undesirable for Bass Lake	no	can suppress growth in some situations, but will not eradicate - good in combination with herbicide	YES*	not practical for a large area, can be useful for individuals	no*	NA	no
	Willow stakes/ revegetation	yes	NA	no	NA	no	NA	no	can reduce biomass but will not eradicate or provide much control	no	replant the area after removal of plant with pasture grasses can suppress further cinquefoil spread	YES*
	water level drawdown	not possible	NA	no	NA	no	NA	no	NA	no	NA	no

broad control method category	Specific method	compatible with Bass Lake water body characteristics	effectiveness for purple loosestrife	further consideration?	effectiveness for Eurasian watermilfoil	further consideration?	effectiveness for knotweed	further consideration?	effectiveness for reed canary grass	further consideration?	effectiveness for sulfur cinquefoil	further consideration?
Mechanical Control Methods	Cutting	yes	when cut at the base at flower-drop, will control the plant for the year. Will not eradicate. Can be part of an IPM solution	YES*	will not control, may spread infestation	no*	will not control, may spread infestation	no*	will not control	no*	mowing will not help, possibly spread	no
	Harvesting	can't be done around docks, logs and other in-water obstructions	NA	no	effective for short term control of large infestations. Will spread smaller infestations. Not suitable for lakes the size of Bass.	no	NA	no	NA	no	NA	no
	Rotovation	Difficult around docks, logs and other in-water obstructions	NA	no	will cause extensive fragmentation and spread infestation	no	NA	no	NA	no	NA	no
	Diver dredging	yes	NA	no	uses a suction dredge to remove plants from soil. Expensive. Can cause fragmentation and spread of infestation	no	NA	no	NA	no	NA	no
	Sediment dredge	Difficult around in-water obstructions, causes water quality issues and fish habitat degradation	NA	no	will not control, may spread infestation	no	Can be effective. Causes severe short-term water quality disturbance. Requires extensive permits. Very expensive	no	will not control, may spread infestation	no	NA	no
	Sediment agitation (weed rollers)	no	NA	no	Useful around individual docks, but NA for larger infestation control	no*	NA	no*	NA	no*	NA	no

broad control method category	Specific method	compatible with Bass Lakewater body characteristics	effectiveness for purple loosestrife	further consideration?	effectiveness for Eurasian watermilfoil	further consideration?	effectiveness for knotweed	further consideration?	effectiveness for reed canary grass	further consideration?	effectiveness for sulfur cinquefoil	further consideration?
Biological Control Methods	grass carp	Possible	NA	no	Grass carp will eat Eurasian watermilfoil but only after they eat most of the other plants in the lake. An inefficient and environmentally costly method for control	no	NA	no	NA	no	NA	no
	Galerucella beetles for purple loosestrife	no -infestation is too small	Possible if the infestation is large enough but at this point to small to support healthy population of beetles	no	NA	no	NA	no	NA	no	NA	no
	Other biocontrol agents for purple loosestrife: seed feeding weevils and root feeding weevils	no -infestation is too small	Not as easy to come by as Galerucella beetles. Not currently on site. Would take several years for populations to build up to controlling levels. Would have to be combined with manual control of seeds	no	NA	no	NA	no	NA	no	NA	no
	milfoil weevils	Not suitable for Bass Lake due to presence of weevil predators (sunfish) and varying population of milfoil	NA	no	may be effective if a reproducing population can be established. This requires proper shoreline habitat and a lack of predators	no	NA	no	NA	no	NA	no

broad control method category	Specific method	compatible with Bass Lake water body characteristics	effectiveness for purple loosestrife	further consideration?	effectiveness for Eurasian watermilfoil	further consideration?	effectiveness for knotweed	further consideration?	effectiveness for reed canary grass	further consideration?	effectiveness for sulfur cinquefoil	further consideration?
Chemical Control	Diaquat	not suitable because it does not kill plant roots	NA	no	will kill plants but roots remain intact, able to re sprout. Does not eradicate the plant.	no	NA	no	NA	no	NA	no
	Endothall	not suitable because it does not kill plant roots	NA	no	will kill plants but roots remain intact, able to resprout. Does not eradicate the plant.	no	NA	no	NA	no	NA	no
	Fluridone	requires whole-lake treatment	NA	no	will control milfoil down to the roots however it can be costly and may not appropriate for spot treatment	YES	NA	no	NA	no	NA	no
	Glyphosate	Spot treat - kills whole plants	not desirable for purple loosestrife control because the chemical is non-selective and monocots (cattails, grasses, and sedges) may be unintentionally damaged in during spraying	no	NA	no	Works well for knotweed especially when combined with imasapyr	YES	Works well for reed canary grass in aquatic formulation, may be combined with willow staking	YES	Could work late summer as part of IPM and replanting	YES
	Imazapyr	Usable at Bass Lake but other herbicides are more cost effective and work just as well	Not desirable for purple loosestrife control because the chemical is non-selective and monocots (cattails, grasses, and sedges) may be unintentionally damaged during spraying	no	NA	no	Works well for knotweed especially when combined with glyphosate	YES	NA	no	NA	no
	Triclopyr	Aquatic formulations are compatible for use	Very effective, if properly applied. Selective so won't harm monocots (cattails, grasses, and sedges)	YES	The Triclopyr TEA formulation can be very effective if properly applied and concentrations are maintained for the required time period.	YES	Works but not effective for long term control	no	Not effective for long term control	no	Early spring summer applications could be beneficial	YES
	2,4-D	Some formulations are compatible	NA	no	Very effective, if correct chemical is properly applied	YES	NA	no	NA	no	Early spring summer applications could be beneficial	YES

## A word about Integrated Pest Management

The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts. IPM uses a multifaceted and adaptive approach. Control methods are selected that reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management of noxious weed problems will require dedication over a number of years, and should allow for flexibility in method as appropriate.

### 7.1 *Myriophyllum spicatum* (Eurasian watermilfoil)

For more information on the following Eurasian watermilfoil control methods reference Appendix A-Control Method Options and Appendix B- Eurasian Watermilfoil Best Management Practices document.

#### 7.1.1 Hand pulling and cutting (only suitable for small areas)

Hand pulling aquatic plants is similar to pulling weeds out of a garden. It involves removing entire plants (leaves, stems, and roots) from the area of concern and disposing of them in an area away from the shoreline. In water less than three feet deep no specialized equipment is required, although a spade, trowel, or long knife may be needed if the sediment is packed or heavy. Hand pulling can be used to temporarily control Eurasian watermilfoil in a small area if repeated on a regular basis. Hand pulling will likely not eradicate the plant from a water body and is impractical for large infestations. All pulled plant parts must be removed from the water, and a Hydraulic Project Approval (HPA) pamphlet permit is required. Several years of monitoring are needed for signs of plants growing from plant fragments. Milfoil can be composted on dry land or placed in yard waste bins.

Cutting differs from hand pulling in that plants are cut and the roots are not removed. Cutting is performed by standing on a dock or on shore and throwing a cutting tool out into the water. A non-mechanical aquatic weed cutter is commercially available. Two single-sided, razor sharp stainless steel blades forming a “V” shape are connected to a handle, which is tied to a long rope. The cutter can be thrown about 20 – 30 feet into the water. As the cutter is pulled through the water, it cuts a 48-inch wide swath. Cut plants rise to the surface where they can be removed. Washington State requires that cut plants be removed from the water. The stainless steel blades that form the V are extremely sharp and great care must be taken with this implement. It should be stored in a secure area where children do not have access. Cutting of milfoil is generally not recommended as it will likely increase the infestation through fragmentation.

### 7.1.2 Diver hand pulling (suitable for small areas or follow-up control)

Diver hand pulling involves the use of divers to carefully pull and bag entire milfoil plants. Divers are able to target just milfoil plants and carefully search the area for missed plants. Bass Lake is a small enough lake where diver hand pulling could be reasonable; however, it is likely to be ineffective as the water color is very dark, making it difficult to see the plants and pull them effectively. Diver hand pulling is an expensive course of action with little likelihood of success. There may also be issues with hiring divers without specific commercial licenses, according to the Washington Department of Labor and Industry.

### 7.1.3 Bottom barriers (only suitable for small areas)

An opaque bottom barrier can be used to suppress milfoil growth in small, discrete areas such as a boat launch or around a swimming area. Barriers need to be regularly cleaned because plants will root in the sediment that accumulates on top of them. They also may balloon up as gases can accumulate underneath from decomposition in the sediments. Fishing hooks also can snag bottom barriers and tear them making them ineffective, and allowing milfoil to grow in the openings. Barriers are likely to be ineffective as Bass Lake has very dark water color and flocculent bottom sediments. These characteristics would make it hard to ensure proper installation and maintenance

### 7.1.4 Chemical control

The use of a formulation of 2,4-D DMA or triclopyr-TEA can provide excellent initial control of the Eurasian watermilfoil (*see Appendix C for herbicide labels*) when the infestation is large and difficult to control with manual methods. Use of these herbicides can be applied in the specific areas of the water where the milfoil plants are growing, thus targeting only those plants and leaving surrounding native submerged plants largely undisturbed. Whole lake treatment with fluridone for milfoil control is expensive and riskier (to non-target plants). The most current surveys suggest that Eurasian milfoil is only found in several discrete locations that could be targeted without treating the entire lake.

The loose sediments in Bass Lake are flocculent and high in organic content throughout the lake's littoral zone. There is some concern that the granular formulations of 2,4-D BEE pellet may settle by gravity into these sediments, which could inhibit the release of the 2,4-D to the water column. If this was the case, the predicted level of control of Eurasian watermilfoil would not be achieved because the concentrations released to the water column might not be high enough to kill the plants. Determination of which form of the herbicides (liquid, pellet, or granular) will be most effective on Bass Lake milfoil can be made on the recommendation of experienced and licensed aquatic herbicide applicators.

Triclopyr-TEA is a fast acting systemic herbicide and is used for submerged plant control. In King County, the pellet formulation of triclopyr has been used in lakes and has been found to have a long resident time, despite the herbicide label stating it breaks down quickly. Careful monitoring of herbicide concentration levels over an extended time period

should be done to make sure that the concentration is high enough to kill the targeted plants but not so high as to go above concentration levels recommended on the label. Two treatments may be required to keep the herbicide concentration at the appropriate level for the desired time period.

#### 7.1.5 Recommended Treatment

Treatments of Eurasian milfoil will likely include hand pulling and spot treatment with selective herbicides. Selective herbicides target dicots, which Eurasian milfoil is. The native milfoil is also a dicot but less receptive to herbicide, while native pondweeds are monocots.

As of 2012, the majority of the *Myriophyllum sp.* was native, which does not pose a threat to the Bass Lake system. While *Myriophyllum spicatum* is present in the lake, it is a very small population.

The Eurasian milfoil will be best controlled with an IPM approach. The focus should be on surveying each year to assess the size of the infestation. Whenever possible, the plants should be pulled, while making sure to collect all the fragments produced by this action. The lake sediments are soft, making it easy to pull the entirety of the milfoil plant, down to the root crown. However, if the infestation begins to increase in areas around the lake (for instance, covers a quarter of the lake) spot treatment of the milfoil using an appropriate herbicide should be used to ensure the milfoil does not create a monoculture in the lake.

A greater number of milfoil plants were found in 2012 than 2011, suggesting Eurasian milfoil could be increasing in the lake again; however, the numbers of plants are not troublesome given the robust nature of the native plants present. If the milfoil infestation increases over the next several years, chemical control is a reasonable and effective option to controlling and possibly eradicating the plant in Bass Lake. It is recommended to use chemical control when the number of plants is large enough that pulling plants from a boat is not a cost-effective option. The chemical herbicides recommended for this project range from no restrictions to restrictions on irrigation. Appendix C contains the herbicide labels that specify the restrictions for each chemical that could be used for this project.

## 7.2 *Lythrum salicaria* (Purple loosestrife)

For more information on the following purple loosestrife control methods reference Appendix A -Control Method Options and Appendix B – Purple Loosestrife Best Management Practices document.

### 7.2.1 Hand pulling (only suitable for small areas or used in combination with other methods)

Hand pulling or digging of purple loosestrife plants is possible in areas where plants are growing out of soft substrate and the root mass of the plants are reachable. The entire root mass must be removed, bagged, and disposed of. Plants that are growing in rock or riprap, in amongst large downed wood, amongst woody vegetation, or located several feet from

the shoreline in wet conditions may not be able to be completely removed using this method. Additionally, while hand pulling is feasible on the small scale, if the purple loosestrife infestation expands along the Bass Lake shoreline, hand pulling and digging on a lake-wide scale would be prohibitively expensive.

Using hand pulling and digging methods to control purple loosestrife is likely to work at Bass Lake, especially if the infestation remains to a very few plants. If surveys show that the infestation is increasing along the shoreline, hand pulling will be part of a larger IPM solution that would incorporate several control tactics.

### 7.2.2 Cutting (used in combination with other methods)

Cutting plants at the base when in flower may prevent seeding, but cut plants may continue to produce flowers. Sites should be consistently and regularly monitored until frost to cut and remove any subsequent flowers. Cutting will not kill the plants, and they will need to be controlled every year. Cut plant parts must not be left on site, because root and stem fragments can take root and form new plants. Care must be taken to properly dispose of root and stem fragments. Using cutting to control purple loosestrife may work at Bass Lake only if it is part of an IPM solution that incorporates several control tactics.

### 7.2.3 Chemical control

If the infestation of purple loosestrife were to expand beyond a reasonable scope for cutting and hand pulling to work as control, herbicide use may be necessary for effective control. The application of herbicide to the emergent purple loosestrife is best conducted by manual spot applications. Control of purple loosestrife is most effectively achieved using a selective herbicide such as an aquatic approved version of triclopyr or 2,4-D (*see Appendix C for herbicide label*). Triclopyr-TEA in particular has been very effective in killing purple loosestrife plants and has the lowest human and ecological side effects. Selective herbicides also have the advantage of not harming monocot plants (cattails, grasses, sedges, etc.). These aquatic herbicides must be used with a Washington State Department of Ecology approved aquatic surfactant.

An experienced and licensed aquatic herbicide applicator can selectively target individual emergent weed species and limit collateral damage to other species. This is especially true when infestations are small so that large areas with a diverse plant distribution do not have to be treated. Currently the loosestrife infestation at Bass Lake appears to be very limited.

### 7.2.4 Recommended Treatment

Treatments of purple loosestrife on Bass Lake will likely have to occur as plants are found. The most appropriate method would be a combination of hand pulling the plants and cutting the seed heads. If the infestation grows beyond a few plants or the plants are difficult to access to cut and/or hand pull, herbicides may need to be used to ensure eradication. In sensitive areas or areas prone to erosion, careful spot-spraying will create fewer disturbances than manual or mechanical control. For several years following

treatment, areas should be monitored for new plants germinating from the seed bank. In some cases several years of treatment may be necessary.

Two areas of plants were found along Bass Lake both in 2011 and 2012. While plants were pulled and seed heads clipped, there is likely a seed bank present along the shoreline from these plants. Eradication is probable if immediate action is taken using a combination of cutting and hand pulling, using chemical control only if deemed necessary.

### 7.3 *Polygonum cuspidatum* (Japanese knotweed)

For more information on the following Japanese knotweed control methods reference Appendix A -Control Method Options and Appendix B – Japanese knotweed Best Management Practices document.

#### 7.3.1 Hand Pulling and cutting (only suitable for small areas)

Hand pulling or cutting is not suitable for large infestation areas of knotweed. The King County Noxious Weed Japanese knotweed control program recommends that manual control methods are only used when the stems of the plant number 50 or less.

Manual methods, consisting of digging up plant roots, and cutting the canes to the ground several times a season can be a larger part of an IPM control strategy. If manual methods are selected for knotweed control, it is important to be sure to plan on several years for this kind of control and activity for many days over the course of each season for proper control.

#### 7.3.2 Bottom Barriers (only suitable for small areas)

The use of bottom barriers for knotweed is only suitable at the beginning of the growing season or after several cutting attempts have been made and slowed down the rapid growth of the plant. A barrier of geotextile fabric or black plastic can be placed on the area and extend 10 feet beyond the known infestation area. The barrier must remain for several growing seasons and be maintained to insure no holes in the barrier allow knotweed to grow through. Plants sprouting alongside the barrier need to be removed and if any plants are seen to be trying to push through, the barrier needs to be trampled. Only when no growth beneath the fabric is observed for a whole growing season can the barrier be removed.

Barriers for knotweed may work in areas where the infestation is very small and used in conjunction with other control methods.

#### 7.3.3 Chemical control

Chemical control used in conjunction with some manual method of control is the most effective way to deal with large infestations of Japanese knotweed.

### ***Foliar applications***

There are several types of chemicals that have been used on knotweed, but the most common and effective combination seems to be imazapyr and glyphosate (F. Lucero, pers. comm.). Glyphosate is non-selective and can cause damage to other area plants if the spray drifts. Repeat applications are likely necessary and work well in conjunction with imazapyr. Imazapyr is a slow-acting but highly effective herbicide. It is systemic and can stay in the soil for up to a year and is taken up by the roots and leaves of the plant and will kill the knotweed slowly over time. Because this herbicide is not highly selective, this treatment limits the possibility of replanting any area where this chemical is used for at least one year.

Foliar applications are most effective when the knotweed is cut back in the spring and summer and the herbicide is sprayed in fall. This method will decrease the amount of herbicide necessary as well as effectively uses labor.

### ***Injection method***

Often knotweed is managed by using an injection gun and injecting herbicide directly into the stem of the knotweed. The injection method is very selective and eliminates drift and does not require any cutting prior to treatment. However, this method is very time intensive as each stem of knotweed needs to be injected with the herbicide and at this point only glyphosate can be used with the injection method. Guns can only be used on stems larger than ½ inch so some small stems will go untreated and proper maintenance of the injection gun is imperative to this method working.

### ***Cut stem/pour applications***

This method is similar to the injection gun method but 3mL of concentrated glyphosate is poured directly into the stem of each knotweed plant using a syringe type piece of equipment. It is very labor intensive like the injection method and would work best on smaller infestations.

### ***Wick-wipe method***

This method uses a sponge at the end of an applicator, like those on a back-pack sprayer, and the herbicide is directly “wiped” onto the leaves of the knotweed. Both imazapyr and glyphosate can be used for this method. While this method greatly reduces drift it is hard to insure the herbicide comes into enough contact with the knotweed to make the application worthwhile.

## **7.3.4 Recommended Treatment**

As with most of the weeds in and around Bass Lake, an IPM approach to Japanese knotweed is recommended. It is imperative that private land owners near the boat launch participate in knotweed control on their property for success in controlling this plant. A combination of cutting and herbicide application, likely a foliar or wick-wipe method, is

appropriate and recommended for the Japanese knotweed infestation at the boat launch of Bass Lake.

## 7.4 *Potentilla recta* (sulfur cinquefoil)

### 7.4.1 Hand pulling (only suitable for small areas)

Small infestations of sulfur cinquefoil can be removed by digging the plants out. It should be done in spring/ early summer while the soil is still moist and before the seeds mature. As much of the plant as possible needs to be dug up and removed as it can spread through root fragments. If the plant is flowering, remove the seed heads and bag very carefully before digging up the rest of the plant. The seeds are very lightweight and small, so they can spread very easily. It will take several years of hand pulling and surveys before an area can be considered controlled or eradicated.

Anyone working in a sulfur cinquefoil infested area should brush off their boots and clothes prior to leaving the infestation site, reducing the chance of accidentally spreading the plant to new areas.

### 7.4.2 Mowing

Mowing will not effectively control any infestation of sulfur cinquefoil. The tops of the plants will be removed but the woody roots will not and will send new growth up soon after mowing. Mowing is only appropriate if the infestation is found late in the year and is necessary to keep the plants from flowering.

### 7.4.3 Chemical Control

Chemical control is an option for infestations that are not suitable for manual removal or too large. Chemicals can be applied by a wicker-wipe system or spot sprayed.

The Nature Conservancy has had success in controlling cinquefoil using a combination of Garlon-3A used at 2.5%. Other herbicides that may be effective are glyphosate, triclopyr, 2,4-D (See herbicide labels, Appendix C).

### 7.4.4 Recommended Treatment

In 2012, no sulfur cinquefoil was found along the shoreline of Bass Lake. However, the plant is found in the larger Bass Lake Complex, so lake surveys should include a search for cinquefoil on the shoreline. If sulfur cinquefoil should ever infest the shoreline at Bass Lake, it is likely that it will be small enough for manual methods to be useful and effective; however, if the infestation becomes larger or is hard to access, a combination of manual removal and chemical control would be effective.

## 7.5 *Phalaris arudinacea* (reed canary grass)

For more information on the following reed canary grass control methods reference Appendix A -Control Method Options, and Appendix B- reed canary grass Best Management Practices document.

### 7.5.1 Hand pulling (only suitable for small areas)

Isolated plants or small infestations can be dug to remove the entire root mass. All rhizomes and roots need to be removed as reed canary grass fragments can resprout. Continual maintenance and surveys will be necessary to ensure the method works.

### 7.5.2 Mowing

Mowing or cutting reed canary grass will not control the plant alone. In fact, unless a rigorous mowing/cutting schedule is followed (at least 5 times a year), mowing or cutting could encourage the infestation to spread. It can help control seed head production if mowing occurs before flowering occurs. Mowing is also a good method to use in conjunction with chemical control and has been noted to be an effective control plan. However, the Bass Lake shoreline is too wet for mowing for this to be a reasonable method.

### 7.5.3 Chemical control

Reed canary grass can be controlled using herbicide; small stands can be effectively controlled with one application but larger infestations, like the one found in the Bass Lake complex, would require repetitive applications over several years. Glyphosate has been proven to be effective on reed canary grass and there are formulations appropriate for wetland/aquatic areas. Foliar sprays from a backpack sprayer in late fall would be the ideal application and when applied after several years of mowing, treatment can be quite effective.

### 7.5.4 Recommended Treatment

In 2012 the population of reed canary grass along the Bass Lake shoreline was quite small. However, there is a large infestation within the complex and eradication is not a likely outcome for Bass Lake. However, in the other efforts around the lake, it could be worthwhile to try and control the reed canary grass along the shoreline. Where feasible and appropriate hand pulling is worth trying while for fast and effective results, chemical control may be the preferred option due to the access issues and labor intensity of manual methods.

## 8.0. INTEGRATED TREATMENT PLAN

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Bass Lake and its associated shoreline contain two listed noxious weed species whose presence can diminish the quality of Bass Lake as an ecological and human resource. There are also three noxious weeds landward from the lake that could potentially threaten the shoreline of the lake and need to be taken into consideration in a comprehensive plan.

The goal of the treatment plan is to halt and even reverse the degradation caused by the listed plants. The two target species, Eurasian watermilfoil (*Myriophyllum spicatum*) and purple loosestrife (*Lythrum salicaria*) require different treatment and monitoring techniques. Populations of Japanese knotweed, reed canary grass and sulfur cinquefoil will need to be tracked to ensure they do not infest the Bass Lake shoreline and are therefore included in this IAVMP with suggestions on how to control them if they reach the lake shoreline. All methods suggested comprise an IPM strategy that strikes a balance between target weed eradication and environmental protection.

### 8.1 Permits

Most aquatic weed control activities require permits from jurisdictions and agencies responsible for managing and protecting natural resources. Many manual and mechanical control methods are covered under the “Aquatic Plants and Fish” pamphlet, an HPA for small projects issued by the Washington Department of Fish and Wildlife that is free of charge and expedites the removal aquatic of noxious weeds. This HPA pamphlet permit applies only to use by individual land owners over small areas and only applies to aquatic noxious weeds, not “beneficial plants” or native plants that may be seen as nuisance weeds. A National Pollutant Discharge Elimination System (NPDES) permit must be obtained before aquatic herbicides can be applied to natural water bodies in Washington State. The Washington Department of Agriculture holds an NPDES permit for the management of noxious weeds growing in wet areas such as lake shores, freshwater wetlands, river banks, and estuaries. Licensed applicators can obtain coverage under this permit free of charge. For herbicide treatment of in-lake plants (floating or submersed weeds) the project will need an Aquatic Plant and Algae Management NPDES permit from the Washington Department of Ecology. This permit must be held by the herbicide applicator or the legal entity hiring the applicator, it must be applied for at least sixty days before the herbicide application, and a permit fee applies. In 2011 the permit fee was \$415 assessed per year through the life of the permit.

The schedule laid out below is tentative and will be reassessed each year depending on the density and distribution of the plants found during surveys.

## 8.2 *Lythrum salicaria* (Purple loosestrife)

### 8.2.1 Initial control (year 1)

A pre-treatment survey of purple loosestrife will occur in late July or early August. The survey will be conducted from a small boat, and all locations of plants will be mapped. First, it will be determined if digging the purple loosestrife plant is appropriate. If it is, the plants will be dug out immediately; if not, chemical treatment using a selective aquatic herbicide will be used. The herbicide will be applied by a licensed aquatic herbicide applicator from a hand held or a backpack sprayer. If herbicide is used, treatment of purple loosestrife plants will occur in mid-August, once most of the plants have flowered. A licensed applicator will be able to accurately spot spray purple loosestrife plants on shore, avoiding non-target plants. In early September, the entire lake shore will be surveyed again for purple loosestrife to determine the thoroughness of the herbicide treatment. As necessary, a second spot treatment of purple loosestrife using herbicide will be scheduled for mid-September.

### 8.2.2 Follow-up control (year 2- 4)

It is anticipated that purple loosestrife control will be necessary in years two, three, and four, and again will use a combination of herbicide treatment and digging follow-up. Pre-treatment surveys of purple loosestrife will occur in late July or early August. The survey will be conducted from a small boat, and all plants will be mapped. Spot herbicide treatment or digging of purple loosestrife plants will be done in conjunction with the survey. In early September the entire lake shore will be surveyed again for purple loosestrife to determine the thoroughness of the herbicide treatment.

Based on the September survey and mapping, manual removal of any remaining purple loosestrife flowers or seed heads will be conducted by mid-September.

## 8.3 *Myriophyllum spicatum* (Eurasian watermilfoil)

### 8.3.1 Initial control (year 1)

A survey of Eurasian watermilfoil will occur in early to mid-July. The survey will be conducted from a small boat. Plant locations will be recorded using a combination of GPS and hand-marked detailed aerial photos incorporated in an electronic mapping file. If only a few plants are found, hand pulling will be done from the boat, assuming the plants can be easily accessed.

If Eurasian milfoil is found in great abundance, control will be accomplished using a selective aquatic herbicide formulation of 2,4-D DMA and/or triclopyr-TEA (see Appendix C for herbicide label). Suitable formulations include, but are not limited to: Renovate® OTF (granular triclopyr-TEA), Navigate® (granular 2,4-D) or Renovate® MAX G (granular

triclopyr-TEA + 2,4-D). The herbicide will be applied by a licensed aquatic herbicide applicator at the label-recommended rate.

If herbicide treatment is warranted, initial treatment will occur in mid to late July when milfoil plants have become visible in the water. Locations to be treated will be based on survey maps, GPS coordinates, and new visual observations of plants as the treatment occurs. A record of which areas were treated and amount of herbicide applied will be kept for 7 years, in addition to all other required herbicide application records. A record of herbicide application will also be entered into the Secure Access database through the State of Washington as part of the NPDES permit.

First year follow-up spot treatment will occur in mid to late August to control any plants that were missed during the July treatment. The second treatment will occur before milfoil plants are expected to fragment, usually early September.

In September, the entire lake will be surveyed for milfoil again to determine the effectiveness of the herbicide treatment. The survey will be conducted by King County staff from a small boat, and any plants found will be mapped. If necessary, plants may be pulled.

### 8.3.2 Follow-up control (years 2-5)

In years following an herbicide treatment, the lake will be surveyed for milfoil in early July. If conditions warrant, one to two rounds of herbicide spot treatment will be scheduled for mid-July and mid to late August. If the milfoil population is small and/or sparse enough, hand pulling will be done and all milfoil pieces will be bagged. A follow-up survey will be done in September regardless of the control method(s) used.

### 8.3.3 Monitoring

The NPDES permit requires monitoring of herbicide levels in the lake after treatment. Samples will be collected at the time of the initial application and again five days post treatment. A baseline sample will also be taken before the application, since water quality experts at Ecology report heightened levels of herbicides in the lake surface water due to runoff after heavy storm events. One sample is taken from within the treatment area, and one from outside. These samples will be sent to an independent, Ecology-accredited laboratory for analysis. Sampling and analysis will continue until the herbicide levels drop below a predetermined threshold. This procedure will be performed in each year in which herbicide is applied.

Surveys after the initial application are essential to determining the success of the effort, and will be used to determine what measures need to be implemented to complete the milfoil control each year.

## 8.4 A note about noxious weeds outside the purview of the IAVMP

Below are treatment method proposals for the three weeds that are included in this IAVMP, but which are not eligible for WDOE aquatic weed grant funding. Any noxious weed that is legally defined can have control implemented as funding allows.

## 8.5 Japanese knotweed

### 8.5.1 Year 1-5

Private property owners will need to be contacted to discuss possible treatment and options on their property. The size of infestation at the boat launch will need to be assessed in early spring. Ideally with approval and the partnership of the private property owners, a combination of cutting the plants and foliar chemical application will be used. It may be worthwhile to try bottom barriers in areas of large infestation to suppress growth, especially along the Department of Fish and Wildlife boat launch. Partnerships Collaboration with the King County Noxious Weed Program and King County Parks will make sure a cohesive plan is followed and the work is done efficiently.

## 8.6 Reed Canary Grass

### 8.6.1 Year 1 -5

While there is a small infestation along the shoreline, a much greater infestation is in the fen and just upland of Bass Lake. Eradicating reed canary grass is not a feasible outcome for this project; however, the population along Bass Lake is currently small enough that it could be controlled to prevent further spreading in this area.

The best control methods would be to dig out reed canary grass where possible and spot treat with glyphosate using the wick-wipe method. Surveying for reed canary grass would be done in spring and treatment would occur in mid-summer or preferably late fall as the plants head into dormancy. Reed canary grass will not be eradicated from the complex, so recurrent surveys will be necessary to prevent the infestation from spreading along the Bass Lake shoreline.

## 8.7 Sulfur Cinquefoil

While not along the shoreline, sulfur cinquefoil is in the complex, and it will be important to keep it from colonizing the shoreline. King County Parks is working on controlling the known infestation before it spreads. If it does reach the lake, a treatment method similar to that for reed canary grass will be recommended: dig out what is possible and spot treat with herbicide.

## 9.0. PLAN ELEMENTS, COSTS, AND FUNDING

Implementation of the Bass Lake IAVMP is scheduled to span five years, at a total estimated cost of \$50,337.00. Table 2 outlines the tasks and estimated costs of implementation on an annual basis. The budget is broken into one year segments. This partitioning will allow for more definitive budget strategizing in the short term and adaptive management in the later years of the project. The majority of the costs are expected to accrue in the first three years, the period of most aggressive treatment for loosestrife. Milfoil treatment will depend on size of the infestation and if herbicide is not necessary costs would be less. As the project progresses, more funds are dedicated to detecting and controlling reintroductions of aquatic noxious weed species.

The treatment and survey costs for Japanese Knotweed, reed canary grass and are included for planning purposes. That work will likely not be funded through an aquatic weed fund grant from Department Ecology.

Table 2. Bass Lake Milfoil Project budget

	Task	Year 1	Year 2	Year 3	Year 4	Year 5	5 Yr Total
noxious weed control	Herbicide-milfoil	\$985	\$985	\$985	\$985	\$985	\$4,925
	Herbicide-Loosestrife	\$785	\$785	\$785	\$785	\$785	\$3,925
	Herbicide-RCG	\$300	\$300	\$300	\$300		\$1,200
	Japanese knotweed	\$2,500	\$2,000	\$2,000			\$6,500
	Herbicide Application Permit	\$415	\$415	\$415	\$415	\$415	\$2,075
	Post-treatment monitoring	\$640	\$640	\$640	\$640	\$640	\$3,200
Weed Surveys		\$1,180	\$1,180	\$1,180	\$1,180	\$1,180	\$5,900
education and outreach	Education and Outreach	\$690	\$690	\$690	\$690	\$690	\$3,450
	Printing Costs	\$250	\$250	\$250	\$250	\$250	\$1,250
Project Administration and Reporting		\$ 1,800	\$ 1,600	\$ 1,600	\$ 1,600	\$ 2,100	\$8,700
		Year 1	Year 2	Year 3	Year 4	Year 5	5 Year Total
	Totals	\$ 9,545	\$8,845	\$8,845	\$6,845	\$7,045	\$41,125
					9.9% tax		\$ 4,071.38
					12.5% contingen		\$ 5,140.63
					<b>Project Total</b>		<b>\$ 50,337.00</b>

## 9.1 Costs of the Plan

### 9.1.1 Planning Costs

Most of the planning has been completed through the creation of this IAVMP. Approximately 75% of the cost of researching, planning for and writing this management plan came in the form of a grant from the Washington State Department of Ecology's Aquatic Weeds Management Fund. The remaining costs came in form of salary match from King County Water and Land Resources Division staff and WRIA 9 staff.

### 9.1.2 Capital Costs

There are no capital costs associated with this IAVMP. It is not anticipated that any equipment will need to be purchased, structures built, or property acquired.

### 9.1.3 Operational and Maintenance Costs

The majority of expenses associated with implementation of the Bass Lake IAVMP are operational and maintenance costs. These costs include mapping and surveying, follow-up weed removal, community outreach, and project administration & management (Table 2).

## 9.2 Sources of Funding

Funding for implementation of the Bass Lake IAVMP will come from a combination of sources that may change as the project progresses. Potential sources of funding such as grants and self-funding were all considered by the Steering Committee. Focusing on grant funding was chosen by the Committee. This funding option depends on a blend of contributed funds, matching cash funds, and matching in-kind volunteer hours.

### 9.2.1 Grants

The logical grant to pursue would be the Washington State Department of Ecology's Aquatic Weeds Management Fund (AWMF). If received, this funding, along with the required match, should be enough to fund the noxious aquatic weed work portion of the plan. This IAVMP has been developed to be consistent with all AWMF guidelines and requirements. Given the small size of the lake and relatively small infestations along the shoreline, the weeds will be easy to control now before they infest the adjoining wetlands and lakes in the complex.

To receive an Ecology grant, the grant will need to be applied for by the local jurisdiction, in this case King County, which will act as liaison between Ecology, contractors, and the community.

### 9.2.2 Matching Funds

Awarding of the Ecology's AWMF grant requires matching funds, which distributes the responsibility of funding between the state agency (Ecology) and the local stakeholders such as MGRC, the King County Noxious Weed Control Program, and King County Parks Natural Lands Program. Both cash match and in-kind match are proposed to be used to fulfill this requirement.

### 9.2.3 Long Term Sustainability

The long-term sustainability of this project is dependent on the commitment of MGRC to follow up weed control and the ability of the staff of the King County staff to communicate weed control techniques, strategies, and priorities. In the absence of an AWMF grant funding options will be re-evaluated by the Steering Committee.

Through their participation in the development of this IAVMP, the MGRC has demonstrated their desire to support this plan for the long term. KC staff will be able to provide specific weed control strategies for situations as they arise in the future. Ideas that have been brought up by community members for long term maintenance of the project's control efforts include:

- Community weed pulling work days
- Community weed surveys

## 10.0. MONITORING, EVALUATION, AND IMPLEMENTATION

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### 10.1 Monitoring

Yearly surveying and monitoring of emergent, floating and submerged aquatic noxious weeds will be conducted at Bass Lake. These surveys will help guide noxious weed control efforts and provide a year-to-year baseline for progress towards weed control/eradication.

### 10.2 Evaluation of the Plan

The effectiveness of the plan will be evaluated yearly. Adaptive changes will be made as needed. Year-to-year comparisons of the monitoring data will be used to evaluate trends in specific target species abundance and distribution. The results of these comparisons will guide control efforts and may result in a change in future control strategies. Success of the plan will be measured by the reduction of the target noxious weed species.

### 10.3 Implementation

The implementation of the plan will follow the process outlined below:

**Convene a project Implementation Committee.** This group will consist of King County staff, interested members of the Bass Lake community, and the Middle Green River Coalition. They will direct implementation of the IAVMP.

**Identify Funding Sources.** The most likely source for funds to support the implementation of the IAVMP is the Washington State Department of Ecology AWMF. Other local and regional grants will be pursued as well. The AWMF grant requires matching funds and time from the local agency and community, and it could fund the first three to four years of the project. This grant requires that the local community work in conjunction with a local government agency; in this case King County Department of Natural Resources and Parks. During the final year of the grant's funding, the need for future funding should be assessed by the Implementation Committee.

**Select an Herbicide Contractor.** An applicator will be selected for treatment of each of the three target weeds outlined in the IAVMP. The treatments will be done either "in-house" by experienced King County DNRP employees or by a competent private contractor. Contractors will be hired according to the King County process if the funding is from a grant awarded to King County. Contract proposals will include costs for permit application and annual invoices, herbicide applications, and notification and postings required by the permits.

**Application of Herbicide.** Application of herbicides will be completed as prescribed in the IAVMP, unless consultation with the community, Ecology and/or the applicator leads to defensible changes in the plan.

**Public Education and Communication.** The residents of Bass Lake will be notified about up-coming herbicide applications as determined by the requirements in the NPDES permit, the results of yearly monitoring efforts, and any major changes made to the plan via the MGRC. Much of this communication will be carried out by active members of the community who are involved with the Implementation Committee. The Committee will take into account public feedback when making decisions about the plan.

**Monitoring Surveys.** Surveys will be done yearly. Surveys will be done at the same time each year in order to get a comparable measure of the plants distribution and density.

**Long-term Monitoring and Maintenance.** This will be done by the Bass Lake community and MGRC after the satisfactory completion of the implementation plan.

## 10.4 Implementation and Evaluation

1. **Convene a project Implementation Committee.**
2. **Review proposed plan and develop timeline with specific tasks.** The IAVMP will guide this process.
3. **Assign tasks to Implementation Committee members.**
4. **Issue a Request for Proposals for weed survey and control work.**
5. **Secure necessary permits.** Permit application will be coordinated with the contracted applicator.
6. **Implement public education and communication plan.**
7. **Apply herbicide treatment.** Application will be completed as prescribed in IAVMP, unless consultation with Ecology and the applicator leads to defensible changes in the plan.
8. **Conduct follow-up surveys.** Professional contractors and community members who have received adequate training can complete this work, with community participation under supervision of King County staff.
9. **Apply follow-up herbicide treatment if necessary.** Follow-up surveys will determine the extent to which this work is necessary.
10. **Conduct future surveys to track success and carry out hand pulling as necessary.** Professional contractors and community members who have received adequate training can complete this work, with community participation under supervision of King County staff.

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## Appendix A – Control Method Options

This document outlines common methods used to control aquatic weeds. Much of the information in this section is quoted directly from the Washington State Department of Ecology's (Ecology) website: <http://www.ecy.wa.gov/programs/wq/plants/management/index.html>

Additional information is derived from the field experience of the King County Noxious Weed Control Program, in particular from King County WLRD employees Katie Messick (Aquatic Noxious Weed Specialist) and Beth leDoux (Water Quality Planner), both WSDA licensed aquatic herbicide applicators. Recommendations found in the 2001 draft version of the "King County Regional Milfoil Plan" have also been taken into consideration.

Control/eradication methods discussed herein include Aquatic Herbicide, Manual Control Methods, Mechanical Control Methods, Environmental Manipulation, Biological Control, and the No Action Alternative.

### Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods that reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and should allow for flexibility in method as appropriate.

## Aquatic Herbicides

### Description

The majority of the following text has been drawn from the Washington State Department of Ecology's website on chemical aquatic weed control:

<http://www.ecy.wa.gov/programs/wq/plants/management/aqua028.html>

Aquatic herbicides are chemicals specifically formulated for use in water to eradicate or control aquatic plants. Herbicides approved for aquatic use by the United States Environmental Protection Agency (EPA) have been reviewed and considered compatible with the aquatic environment when used according to label directions. However, individual states may also impose additional constraints on their use.

### *About Aquatic Herbicides*

Aquatic herbicides are sprayed directly onto floating or emergent aquatic plants, or are applied to the water in either a liquid or pellet form.

- *Systemic* herbicides are capable of killing the entire plant by translocating from foliage or stems and killing the root.
- *Contact* herbicides cause the parts of the plant in contact with the herbicide to die back, leaving the roots alive and capable of re-growth.

- *Non-selective* herbicides will generally affect all plants that they come in contact with, both monocots and dicots.
- *Selective* herbicides will affect only some plants (usually dicots – broad leafed plants like Eurasian watermilfoil will be affected by selective herbicides whereas monocots like Brazilian elodea and our native pondweeds may not be affected). Most submersed aquatic plants are monocots

Because of environmental risks from improper application, aquatic herbicide use in Washington State waters is regulated and has certain restrictions. The Washington State Department of Agriculture must license aquatic applicators.

- Coverage under a discharge permit called a National Pollutant Discharge Elimination System (NPDES) permit must be obtained before aquatic herbicides can be applied to waters of the state. The Washington Department of Agriculture holds an NPDES permit for the management of noxious weeds growing in wet areas such as lake shores, freshwater wetlands, river banks, and estuaries. Licensed applicators can obtain coverage under this permit free of charge. Information about this permit is available here:  
[http://www.ecy.wa.gov/programs/wq/pesticides/final\\_pesticide\\_permits/noxious/noxious\\_index.html](http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/noxious/noxious_index.html).
- For in-lake projects (floating or submersed weeds) applicators and/or the state or local government sponsoring the project must obtain coverage under Ecology's Aquatic Plant and Algae Management NPDES permit before applying herbicides. Information on this permit is available here:  
[http://www.ecy.wa.gov/programs/wq/pesticides/final\\_pesticide\\_permits/aquatic\\_plants/aquatic\\_plant\\_permit\\_index.html](http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/aquatic_plants/aquatic_plant_permit_index.html).

The Washington Department of Ecology requires notification and posting before treatment. There are additional mitigations to protect rare plants or threatened and endangered species.

Although there are a number of EPA registered aquatic herbicides, the Department of Ecology currently issues permits for seven aquatic herbicides (as of 2011 treatment season). Several other herbicides are undergoing review and it is likely that other chemicals may be approved for use in Washington in the future.

The chemicals that are currently permitted for use in 2012 under the Aquatic Plant and Algae Control Permit and the Noxious Weed Permit are (see **Appendix C** for examples of herbicide labels):

- **Glyphosate** - Trade names for aquatic products with glyphosate as the active ingredient include Rodeo®, AquaMaster®, and AquaNeat®. This systemic broad spectrum herbicide is used to control floating-leaved plants like water lilies and shoreline plants like purple loosestrife. It is generally applied as a liquid to the leaves. Glyphosate does not work on underwater plants such as Eurasian watermilfoil. Although glyphosate is a broad spectrum, non-selective herbicide, a good applicator can somewhat selectively remove targeted plants by focusing the spray only on the plants to be removed. Plants can take several weeks to die and a repeat application is often necessary to remove plants that were missed during the first application.

- **Fluridone** - Trade names for fluridone products include Sonar® and Whitecap®. Fluridone is a slow-acting systemic herbicide used to control Eurasian watermilfoil and other underwater plants. It may be applied as a pellet or as a liquid. Fluridone can show good control of submersed plants where there is little water movement and an extended time for the treatment. Its use is most applicable to whole-lake or isolated bay treatments where dilution can be minimized. It is not effective for spot treatments of areas less than five acres. It is slow-acting and may take six to twelve weeks before the dying plants fall to the sediment and decompose. When used to manage Eurasian watermilfoil in Washington, fluridone is applied several times during the spring/summer to maintain a low, but consistent concentration in the water. Granular formulations of fluridone are proving to be effective when treating areas of higher water exchange or when applicators need to maintain low levels over long time periods. Although fluridone is considered to be a broad spectrum herbicide, when used at very low concentrations, it can be used to selectively remove Eurasian watermilfoil. Some native aquatic plants, especially pondweeds, are minimally affected by low concentrations of fluridone.
- **2,4-D** - There are two formulations of 2,4-D approved for aquatic use. The granular formulation contains the low-volatile butoxy-ethyl-ester formulation of 2,4-D (Trade names include AquaKleen® and Navigate®). The liquid formulation contains the dimethylamine salt of 2,4-D (Trade names include DMA\*4IVM). 2,4-D is a relatively fast-acting, systemic, selective herbicide used for the control of Eurasian watermilfoil and other broad-leaved species. Both the granular and liquid formulations can be effective for spot treatment of Eurasian watermilfoil. 2,4-D has been shown to be selective to Eurasian watermilfoil when used at the labeled rate, leaving native aquatic species relatively unaffected. By court-order the butoxy-ethyl-ester formulation of 2,4-D cannot be used in waters with threatened and endangered salmon-bearing waters in the Pacific Northwest.
- **Diquat** - A trade name for diquat is Reward®. Diquat is a fast-acting non-selective contact herbicide which destroys the vegetative part of the plant but does not kill the roots. It is applied as a liquid. Typically diquat is used primarily for short term (one season) control of a variety of submersed aquatic plants. It is very fast-acting and is suitable for spot treatment. However, turbid water or dense algal blooms can interfere with its effectiveness
- **Endothall** - A trade name for the dipotassium salt of endothall is Aquathol®. Endothall is a fast-acting non-selective contact herbicide which destroys the vegetative part of the plant but generally does not kill the roots. Endothall may be applied in a granular or liquid form. Typically endothall compounds are used primarily for short term (one season) control of a variety of aquatic plants. However, there has been some recent research that indicates that when used in low concentrations, endothall can be used to selectively remove exotic weeds; leaving some native species unaffected. Because it is fast acting, endothall can be used to treat smaller areas effectively.
- **Triclopyr-TEA** - Trade names for triclopyr TEA include Garlon® 3A and Renovate 3®. There are two formulations of triclopyr. It is the TEA formation of triclopyr that is registered for use in aquatic or riparian environments. Triclopyr, applied as a liquid, is a relatively fast-acting, systemic, selective herbicide used for the control of Eurasian watermilfoil and other broad-leaved species such as purple loosestrife. Triclopyr can be

effective for spot treatment of Eurasian watermilfoil and is relatively selective to Eurasian watermilfoil when used at the labeled rate. Many native aquatic species are unaffected by triclopyr. Triclopyr is very useful for purple loosestrife control since native grasses and sedges are unaffected by this herbicide. When applied directly to water, Ecology has imposed a 12-hour swimming restriction to minimize eye irritation. Triclopyr received its aquatic registration from EPA in 2003 and was allowed for use in Washington in 2004.

- **Imazapyr** - Trade names for imazapyr include Habitat® and Polaris ®. This systemic broad spectrum, slow-acting herbicide, applied as a liquid, is used to control emergent plants like spartina, reed canarygrass, and phragmites and floating-leaved plants like water lilies. Imazapyr does not work on underwater plants such as Eurasian watermilfoil. Although imazapyr is a broad spectrum, non-selective herbicide, a good applicator can somewhat selectively remove targeted plants by focusing the spray only on the plants to be removed. Imazapyr was allowed for use in Washington in 2004.
- **Adjuvants** - There are a number of adjuvants (**surfactants**, stickers, sinking agents) allowed for use under the NPDES permits. It is important that a surfactant be used as specified on the herbicide label to improve efficacy. In addition to careful selection of the aquatic herbicide used, selecting the appropriate adjuvant ensures the herbicide gets absorbed by the target plant. Approved aquatic surfactants ensure good plant contact while reducing/minimizing the detrimental effect of the substances to the greater ecosystem. Terrestrial herbicide surfactants can cause great harm to aquatic animals. Ecology supplies a list of adjuvants that are approved for use in aquatic situations. Often used non-ionic aquatic surfactants include Agri-Dex, Competitor, and LI-700. Ecology has approved a list of over 20 aquatic surfactants and it is largely up to the hired contractor as to which one they use.

#### **Advantages (to the use of aquatic herbicides):**

- Aquatic herbicide application can be less expensive than other aquatic plant control methods, especially when used in controlling wide-spread infestations of state-listed noxious aquatic weeds.
- Aquatic herbicides are easily applied around docks and underwater obstructions.
- Washington has had some success in eradicating Eurasian watermilfoil, a state listed noxious weed, from some smaller lakes (350 acres or less) using aquatic herbicides.

#### **Disadvantages (to the use of aquatic herbicides):**

- Some herbicides have swimming, drinking, fishing, irrigation, and water use restrictions (check the label and general permit).
- Non-targeted plants may be damaged or killed by some herbicides.
- Depending on the herbicide used, it may take several days to weeks or several treatments during a growing season before the herbicide controls or kills treated plants.
- Rapid-acting herbicides like endothall and diquat may cause low oxygen conditions to develop as plants decompose. Low oxygen can cause fish kills.
- To be most effective, generally herbicides must be applied to actively-growing plants, although sometimes fall applications of perennial plants can also be effective.

- Aquatic herbicides must be applied by licensed pesticide applicators. Application of herbicides to control submersed plants can be challenging and is best done by an experienced applicator. Many people have strong feelings against using chemicals in water. Community consensus is highly encouraged to ensure the success of lake weed control using herbicides.

### **Costs**

Approximate costs for one-acre submerged or floating plant herbicide treatment:

- Glyphosate (not for submersed plant control): \$500-\$600
- Fluridone: \$900 - \$1,000
- 2,4-D: \$700
- Endothall (not for floating plant control): \$650
- Diquat (not for floating plant control): \$300 - \$400
- Triclopyr-TEA: \$1,000
- Imazapyr (not for submersed plant control): \$700-\$800

### **Toxicology overview**

EPA studies yield the parameters LD<sub>50</sub> (acute lethal dose to 50% of a test population), NOEL (No Observable Effect Level, which is the highest test dosage causing no adverse responses), and RfD (EPA Reference Dose determined by applying at least a 100-fold uncertainty factor to the NOEL). The EPA defines the RfD as the level that a human could be exposed to daily with reasonable certainty of no adverse effect from any cause, in other words, a "safe" dose. Exposures to bystanders or consumers are deemed safe when the RfD is not exceeded (King County, 2003). Since all substances, natural or manmade, may prove toxic at a sufficiently high dose, one should remember the old adage "dose makes the poison." The LD<sub>50</sub> value is useful for comparing one compound with another and for grouping compounds into general hazard classes. The higher the LD<sub>50</sub> value the less toxic the substance is.

Any pesticide, such as 2,4-D, glyphosate or triclopyr TEA, that does not produce adverse effects on aquatic organisms until levels in water reach milligram per liter (i.e., mg/L, equivalent to a part per million (ppm)) would be considered of comparatively low hazard (King County, 2003). Substances that are biologically active in water at levels onethousand-fold less, (i.e., µg/L, parts per billion, ppb), are considered highly hazardous to aquatic life. Most pesticides falling in the latter category are insecticides rather than herbicides.

Also, compounds that have half-lives less than 100 days are considered non-persistent compared to compounds having half-lives approaching one year or longer (for example, DDT). The half-life of 2,4-D is about 7 days in water, the half life of triclopyr TEA is about 7 days in water, and the half life of glyphosate is about 12 days in water. Since there are multiple factors that modulate the pesticides' hazard, just focusing on the half-life itself is a bit misleading for hazard assessment. It is now known that the longer a residue remains in soil/sediment, the less likely it will be taken up by plants, leach, or runoff (King County, 2003). This phenomenon is called residue aging and involves changes in the forces governing interactions of the chemical with the soil matrix over time.

## 2,4-D

As far as restrictions for aquatic 2,4-D applications, there is no fishing restriction, and three to five days after treatment the water is generally below the drinking water standard (70ppb (parts-per-billion), irrigation standard is 100ppb for broad-leafed plants). Although 2,4-D should not damage grass or other monocots, it is not recommended that one use treated water to water lawns during this first three to five days since over-spray will kill ornamentals or plants such as tomatoes and grapes that are very sensitive to 2,4-D. When used according to label directions, there are no swimming restriction for 2,4-D use. Ecology *advises* that swimmers wait for 24 hours after application before swimming in the treatment area, but that is an advisory only. The choice is up to the individual.

### **Human and general mammalian health- 2,4-D**

The oral LD50 for 2,4-D (acid) is 764 mg/kg and the dermal LD50 is >2000 mg/kg. This chemical has a low acute toxicity (from an LD50 standpoint, is less toxic than caffeine and slightly more toxic than aspirin). The RfD for 2,4-D (acid) is 0.01 mg/kg/d. Recent, state-of-the-art EPA studies continue to find that it is not considered a carcinogen or mutagen, nor does it cause birth defects. It has a relatively short persistence in water, since it tends to bind to organic matter in the sediments. The herbicide 2,4-D generally does not bioaccumulate to a great extent, and the small amounts which do accumulate are rapidly eliminated once exposure ceases (Washington State Department of Ecology, 2001).

The risks to human health from exposure to aquatic 2,4-D applications were evaluated in terms of the most likely forms of contact between humans and the water to which the herbicide was applied. Ecology's Risk Assessment results indicate that 2,4-D should present little or no risk to the public from acute (one time) exposures via dermal contact with the sediment, dermal contact with water (swimming), or ingestion of fish (Washington State Department of Ecology, 2001). Based on the low dermal absorption of the chemical, the dose of 2,4-D received from skin contact with treated water is not considered significant. Dose levels used in studies are often far beyond what an animal or human would experience as a result of an aquatic application. Many experiments have examined the potential for contact by the herbicide applicator, although these concentrations have little relevance to environmental exposure by those not directly involved with the herbicide application. Once the herbicide has entered the water, its concentration will quickly decline because of turbulence associated mixing and dilution, volatilization, and degradation by sunlight and secondarily by microorganisms (King County, 2003).

Results of chronic exposure assessments indicate that human health should not be adversely impacted by chronic 2,4-D exposure via ingestion of fish, ingestion of surface water while swimming, incidental ingestion of sediments, dermal contact with sediments, or dermal contact with water (Washington State Department of Ecology, 2001). Pharmacokinetic investigations have demonstrated that 2,4-D is rapidly absorbed from the gastrointestinal tract and is quickly excreted. Animal toxicological investigations carried out at high doses showed a reduction in the ability of the kidneys to excrete the chemical, and resulted in some systemic toxicity. However, the high doses tested may not be relevant to the typical low dose human exposures resulting from labeled use. A review of the scientific and medical literature failed to provide any human case reports of systemic toxicity or poisoning following overexposure to these herbicide products when used according to label instructions (Washington State Department of Ecology, 2001). The risks to mammalian pets and wildlife should be closely related to these reported human risks, especially since many of the toxicity experiments are carried out on test animals by necessity.

*Results indicate that 2,4-D should present little or no risk to the public from acute exposures via dermal contact with sediment, dermal contact with water, or ingestion of fish. Dermal contact with vegetation may present limited risk if it is contacted one hour after application. By 24 hours post-application non-carcinogenic risk is essentially nonexistent, as 2,4-D is unavailable for dermal uptake. Margins of safety for all acute exposure scenarios are greater than "100", implying that risk of systemic, teratogenic, or reproductive effects to humans is negligible.*

(Washington State Department of Ecology, 2001)

The potential hazard to pregnant women and to the reproductive health of both men and women was evaluated. The results of the 2,4-D developmental or teratology (birth defects) and multigenerational reproduction studies indicate that the chemical is not considered to be a reproductive hazard or cause birth defects (teratogen) when administered below maternally toxic doses (Washington State Department of Ecology, 2001). A review of the histopathological sections of various 2,4-D subchronic and chronic studies provides further support that the chemical does not affect the reproductive organs, except in some higher dose groups beyond the potential level of incidental exposure after an aquatic weed application.

#### **Aquatic animal health- 2,4-D**

Based on laboratory data reported in the Department of Ecology's Risk Assessment of 2,4-D, 2,4-D DMA has a low acute toxicity to fish (LC50  $\geq$  100 to 524 mg a.i./L for the rainbow trout and bluegill sunfish respectively). No Federally sensitive, threatened or endangered species were tested with 2,4-D DMA. However, it is likely that endangered salmonids would not exhibit higher toxic effects to 2,4-D DMA than those seen in rainbow trout. Since the maximum use rate of 2,4-D DMA would be no higher than the maximum labeled use rate (4.8 mg a.i./L) even the most sensitive fish species within the biota should not suffer adverse impacts from the effects of 2,4-D DMA. In conclusion, 2,4-D DMA will not affect fish or free-swimming invertebrate biota acutely or chronically when applied at typical use rates of 1.36 to 4.8 mg a.i./L (Washington State Dept. of Ecology, 2001). However, more sensitive species of benthic invertebrates like glass shrimp may be affected by 2,4-D DMA, but 80 and 90% of the benthic species should be safe when exposed to 2,4-D DMA acutely or chronically at rates recommended on the label. Field work indicates that 2,4-D has no significant adverse impacts on fish, free-swimming invertebrates and benthic invertebrates, but well designed field studies are in short supply.

According to the Department of Ecology's Risk Assessment of 2,4-D, in the United States, 2,4-D BEE is the most common herbicide used to control aquatic weeds. 2,4-D BEE, has a high laboratory acute toxicity to fish (LC50 = 0.3 to 5.6 mg a.i./L for rainbow trout fry and fathead minnow fingerlings, respectively). Formal risk assessment indicates that short-term exposure to 2,4-D BEE should cause adverse impact to fish since the risk quotient is above the acute level of concern of 0.01 (RQ = 0.1 ppm/0.3 ppm = 0.33). However, the low solubility of 2,4-D BEE and its rapid hydrolysis to 2,4-D acid means fish are more likely to be exposed to the much less toxic 2,4-D acid. 2,4-D acid has a toxicity similar to 2,4-D DMA to fish (LC50 = 20 mg to 358 mg a.i./L for the common carp and rainbow trout, respectively). In contrast, formal risk assessment with 2,4-D acid indicates that short-term exposure to 2,4-D BEE should not cause adverse impact to fish since the risk quotient is below the federal level of concern of 0.01 (RQ = 0.1 ppm/20 ppm = 0.005). To conclude, 2,4-D BEE will have no significant impact on the animal biota acutely or chronically when using applied rates recommended on the label (Washington State Dept. of Ecology, 2001). Although laboratory data indicates that 2,4-D BEE may be toxic to fish, free-swimming invertebrates and benthic

invertebrates, data indicates that its toxic potential is not realized under typical concentrations and conditions found in the field. This lack of field toxicity is likely due to the low solubility of 2,4-D BEE and its rapid hydrolysis to the practically non-toxic 2,4-D acid within a few hours to a day following the application.

2,4-D is not considered hazardous to beneficial insects due to its low insecticidal activity and an adequate safety margin when products containing 2,4-D are used at recommended levels (National Pesticide Information Center, 2008).

## **Glyphosate**

Glyphosate is a broad spectrum (non-selective) herbicide that is for use on non-submerged plants. The chemical works to inhibit an enzyme that is involved with the synthesis of amino acids, which are critical to plant growth (National Pesticide Information Center, 2010). Glyphosate is absorbed through foliage and translocated to the actively growing parts of the plant (National Pesticide Information Center, 2010). This slow acting herbicide may take up to 20 days to kill the plant. Several manufactures produce aquatic formulated versions of glyphosate.

In relation to shoreline applications, glyphosate is moderately persistent in soil, with an estimated average half-life of 47 days. It is strongly adsorbed to most soils, even those with lower organic and clay content. Thus, even though it is highly soluble in water, field and laboratory studies show it does not leach appreciably, and has low potential for runoff (except as adsorbed to colloidal matter). One estimate indicated that less than 2% of the applied chemical is lost to runoff (Malik et. al., 1989). Microbes are primarily responsible for the breakdown of the product, and volatilization or photodegradation losses will be negligible.

### **Human and general mammalian health**

Examination of mammalian toxicity has shown that the acute oral and dermal toxicity of glyphosate would fall into EPA's toxicity category III. This category characterizes slightly to moderately toxic compounds. Glyphosate is practically nontoxic by ingestion, with a reported acute oral LD50 of 5600 mg/kg in tested rats. The risks of incidental contact from swimming in treated water have also been judged as low with a dermal LD50 of 7940 mg/kg, a very high threshold. The RfD for glyphosate is 0.1 mg/kg/d. To place the level of hazard to humans in perspective, the commonly consumed chemicals caffeine (present in coffee, tea, and certain soft drinks), aspirin (acetylsalicylic acid), and nicotine (the neuroactive ingredient in tobacco) have acute oral LD50's of 192, 1683, and 53 mg/kg, respectively. Thus, the herbicides for the most part are comparatively less toxic than chemicals to which consumers voluntarily expose themselves (King County, 2003).

Since the shikimic acid pathway does not exist in animals, the acute toxicity of glyphosate is very low. Animal studies, which the Environmental Protection Agency has evaluated in support of the registration of glyphosate, can be used to make inferences relative to human health. The EPA has classified glyphosate as a compound with evidence of non-carcinogenicity for humans (National Pesticide Information Center, 2010). This conclusion is based on the lack of convincing carcinogenicity evidence in adequate studies in two animal species. Laboratory studies on glyphosate using pregnant rats (dose levels up to 3500 mg/kg per day) and rabbits (dose levels up to 350 mg/kg per day), indicated no evidence of teratology (birth defects). A three-generation reproduction study in rats did not show any adverse effects on fertility or reproduction at doses up

to 30 mg/kg per day. Glyphosate was negative in all tests for mutagenicity (the ability to cause genetic damage).

### **Aquatic animal health**

Technically, glyphosate acid is practically nontoxic to fish and may be slightly toxic to aquatic invertebrates (EXTOXNET, 1994). Some formulations may be more toxic to fish and aquatic species due to differences in toxicity between the salts and the parent acid, or to surfactants used in the formulation. There is a very low potential for the compound to build up in the tissues of aquatic invertebrates or other aquatic organisms. In water, glyphosate is strongly adsorbed to suspended organic and mineral matter and is broken down primarily by microorganisms.

### **Triclopyr-TEA**

*The following information and citations on triclopyr-TEA are taken from the Washington State Department of Ecology's website on Aquatic Plant Management.*

<http://www.ecy.wa.gov/biblio/0410018.html> (WA Dept. of Ecology EIS for triclopyr, 2004)

[http://www.ecy.wa.gov/programs/wq/pesticides/final\\_pesticide\\_permits/noxious/triclopyr\\_faq.pdf](http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/noxious/triclopyr_faq.pdf) as well as the National Pesticide Information Center (2001).

Triclopyr, ((3,5,6-trichloro-2-pyridinyl) oxyacetic acid) is an aquatic herbicide that utilizes a systemic mode of action used to control submerged, floating and emergent aquatic plants in both static and flowing water. It is also registered for a number of terrestrial uses including broadleaf weed control.

Triclopyr is a growth hormone of the *auxin* type. An auxin-type herbicide interferes with growth after the plant emerges. It contacts leaves, where sugar is produced, and moves to roots, tips, and parts of the plant that store energy, thereby interrupting growth. Since the movement of sugars from the leaves to other parts of the plant is essential for growth, this type of herbicide has the potential to kill simple perennial and creeping perennial weeds with only one or two foliar applications. Bending and twisting of leaves and stems is evident almost immediately after application. Delayed symptom development includes root formation on dicot stems: misshapen leaves, stems and flowers; and abnormal roots. Triclopyr has been claimed to be effective for a variety of fully or partially aquatic plants including Eurasian watermilfoil (*Myriophyllum spicatum*), fragrant water lily (*Nymphaea odorata*), and purple loosestrife (*Lythrum salicaria*). Triclopyr will not affect monocot plants such as pondweed species and coontail, rushes and cattails.

Triclopyr is formulated as a solution in water. Intentionally added inert or "other" ingredients in triclopyr formulations include water and triethanol amine (TEA). The water serves as the primary diluent/solvent in the liquid product while the triethanol amine is used to form the salt of the technical grade active ingredient.

DowElanco currently manufactures and distributes Garlon® 3A and SEPRO Corporation markets and distributes Renovate®3 under a separate label. The products are the same; DowElanco manufactures both products. The Renovate® label specifies selective control of nuisance and exotic plants such as Eurasian watermilfoil (*Myriophyllum spicatum*) and purple loosestrife (*Lythrum salicaria*).

### **Human and general mammalian health**

The oral LD<sub>50</sub> for Triclopyr-TEA is 1,847 mg/kg and the dermal LD<sub>50</sub> is >5,000 mg/kg (SePRO, 2008). The Reference Dose (RfD) for Triclopyr TEA is 0.05 mg/kg/day and the NOEL (no observed

effect level) is 5.0 mg/kg/day. Concentrated triclopyr products are corrosive and can cause skin irritation and irreversible eye damage if splashed in the eye. However, only dilute amounts of triclopyr are needed to kill Eurasian watermilfoil. These dilute concentrations have not been shown to cause skin irritation or other health effects. Triclopyr is not well absorbed through skin. If ingested, research has shown that low doses of triclopyr are rapidly excreted in humans and are unlikely to accumulate in human tissue or cause adverse effects.

In natural waters, the initial breakdown products of triclopyr are TCP and TMP. Tests in laboratory animals on both these metabolites have shown that their toxicity to mammals is less than or equal to triclopyr. These metabolites are relatively short lived in the environment. Complete breakdown of triclopyr results in carbon dioxide, oxamic acid, and other low molecular weight carboxylic acids. Triclopyr and its metabolites are excreted rapidly in humans and mammals. A study in human volunteers, given low doses showed that blood levels peaked two to three hours after ingestion and declined to undetectable levels within 48 hrs. A study in rodents showed that triclopyr and metabolites have a short residence time in other bodily tissues (12-15 hours).

Triclopyr is not considered to be a cause of cancer, birth defects, or genetic mutations. Nor is it considered likely to cause systemic, reproductive, or developmental effects in mammals at or near concentrations encountered during normal human use. However, Washington State Department of Health considers it prudent public health advice to minimize exposure to pesticides regardless of their known toxicity (Washington State Department of Ecology, 2004).

The only health concerns from triclopyr for swimming are minor eye irritation and exposure to children immediately after application. The risk of eye irritation and overexposure for children decreases rapidly because of dilution. A mandatory waiting time after application before swimming is allowed, mitigates the risk (Washington State Department of Ecology, 2004).

Exposure and risk calculations were determined for hypothetical situations involving ingestion and dermal contact with treated water while swimming and drinking potable water. Calculation of triclopyr exposures utilized the swimmer's weight, the skin surface area available for exposure, the amount of time spent in the treated water containing 2.5 and 0.5 ppm triclopyr, amount of water swallowed while swimming over specific time periods, and the estimated human skin permeability coefficient (Washington State Department of Ecology, 2004).

Risk analyses were completed for various populations. The most sensitive population was found to be children who swim for three hours and ingest water while swimming. However, a child would have to ingest 3.5 gallons of lake water where triclopyr had been recently applied to cause risk factors to be exceeded. Based on the label use directions and the results of the triclopyr toxicology studies, the aggregate or combined daily exposure to the chemical from aquatic herbicidal weed control does not pose an adverse health concern (Washington State Department of Ecology, 2004).

The Washington State Dept. of Health has *recommended* a 12-hour restriction for re-entry into triclopyr treated water to assure that the eye irritation potential and any other adverse effects will not occur. WDOH also recommends that those wanting to avoid even small exposures can wait one to two weeks following application when the triclopyr residues have dissipated from the water and sediments (Washington Department of Health, 1999).

### **Aquatic animal health**

Triclopyr TEA and triclopyr acid are practically non-toxic to aquatic invertebrates and are not anticipated to be an acute or chronic risk due to their fairly short half-life (typically <5 days), low intrinsic toxicity to animals, and low tendency to accumulate in animal tissue. In the field where triclopyr TEA was used to control Eurasian watermilfoil, waterhyacinth, or purple loosestrife, no invertebrate mortality or changes in invertebrate population structure was seen that could be attributed to the use of triclopyr TEA (Washington State Department of Ecology, 2004).

Most species of fish are tolerant of triclopyr TEA. There have been no verified cases of toxicity to fish when triclopyr is used at the maximum use rate of 2.5 ppm. For aquatic organisms, the acute toxicity values for triclopyr varies by species (values for acute 96-hr LC<sub>50</sub> ppm): rainbow trout (86-117), salmon species (82-182), and bluegill sunfish (148). The Environmental Protection agency Toxicity Rating system categorizes: "Slightly toxic(acute values 10-100 ppm) to Practically non-toxic (>100 ppm)".

All of these values are well above the maximum use rate of triclopyr TEA of 2.5 ppm. These species have LC<sub>50</sub> values that are >10-fold greater than the expected environmental concentration (EEC) that occurs immediately after application therefore it is not likely that they would be adversely impacted by the effects of triclopyr TEA. In general, triclopyr TEA can be considered to have very low toxicity to environmentally relevant fish and aquatic invertebrates. Triclopyr TEA appears to be extremely safe for use in the presence of threatened and endangered salmonid game-fish.

### **Suitability for Bass Lake**

Aquatic herbicides *can* provide an effective method for control and eventual eradication of noxious weeds at Bass Lake. Success in using aquatic herbicides to control aquatic noxious weeds is contingent upon many factors: correct formulation, timing, application method, adjuvants (surfactants) used, weather conditions when applied, etc. Also, the application of aquatic herbicide to all aquatic plants (emergent, floating, or submerged) is required to be done by Washington State Department of Agriculture Certified Aquatic Herbicide Applicator and requires the obtaining of an Aquatic Plant and Algae Management Permit from Washington State Department of Ecology.

**Submerged and Floating Plant Control.** Chemical control of the submerged aquatic weeds, Eurasian watermilfoil, require the use of specially formulated and applied herbicides.

The use of a formulation of 2,4-D DMA or triclopyr-TEA should provide excellent initial control of the Eurasian watermilfoil. Use of these herbicides, while applied to the water column, can be applied in the specific areas where the milfoil plants are growing, thus targeting only those plants and leaving the surrounding native submerged plants largely undisturbed. An expensive and riskier (to non-target plants) lake-wide treatment with fluridone for control of Eurasian watermilfoil is un-necessary because of the scattered nature of the infestation.

The loose sediments in Bass Lake are high in organic content and are flocculent around much of the lake's littoral zone. There is some concern that the granular formulations of 2,4-D BEE may settle by gravity into these sediments, which could inhibit the release of the 2,4-D to the water column. If this was the case, the predicted level of control of Eurasian watermilfoil would not be achieved because the concentrations released to the water column may not be high enough to kill the plants. Determination of which form of the herbicides is used (liquid, pellet, or granular) will be most

effective at Bass Lake can be made on the recommendation of experienced aquatic herbicide applicators.

Triclopyr-TEA use for submerged plant situations requires careful monitoring if herbicide concentration levels over an extended time period to make sure that the concentration is high enough to kill the targeted plants but not so high as to cause adverse side effects. Two treatments may be required to keep the herbicide concentration at the appropriate level for the desired time period.

One of the main reasons to eradicate milfoil is to maintain the health of the native aquatic plant community for all of the species that utilize them in their life cycles, as well as to maintain the viability of the lake for human recreational uses. The nature of the control methods to be implemented will minimize impacts to native aquatic vegetation. The control of the Eurasian watermilfoil will be conducted by methods designed to preserve (and eventually enhance or conserve) the native plant communities. Herbicide selective to Eurasian watermilfoil will be used for its control and will not require a whole-lake treatment that would expose all the submersed plants to the herbicide.

Follow-up control methods (diver hand pulling and/or diver dredging) will focus specifically on these two target species and should also leave beneficial plants intact. With these constraints in place, conservation areas should not need to be established to serve vital ecosystem functions until native plants re-establish.

### **Emergent Plant Control**

The application of herbicide to the emergent species (purple loosestrife) is best conducted by manual spot applications. Control of purple loosestrife is most effectively achieved using a selective herbicide such as an aquatic approved version of triclopyr or 2,4-D. Triclopyr-TEA in particular has been very effective in killing purple loosestrife plants and has the lowest human and ecological side effects.

An experienced herbicide applicator can selectively target individual emergent weed species and limit collateral damage to other species to a minimum. This is especially true when infestations are small so that large areas with a diverse plant distribution don't have to be treated. Since the emergent noxious weed infestations at Bass Lake are still confined largely to the shoreline, it should be relatively simple for the applicator to avoid significant collateral damage and preserve the native plant community.

### **Water Use Restrictions**

Some residents may have water right claims on Bass Lake and occasionally use lake water to irrigate their yards. Use of lake water that had recently been treated with herbicide to water landscape or vegetable gardens may cause damage to those plants. To ensure that all residents who might draw water from the lake are aware of water use restrictions, there will be announcements sent to all lakeside residents prior to each herbicide treatment. One announcement will be sent at the beginning of the summer with approximate dates of planned treatments, and subsequent announcements will be sent 7-10 days prior to each treatment, with exact dates of treatment and use restrictions.

## **Manual Control Methods**

## **(hand pulling, diver hand pulling, raking, cutting using hand tools)**

### **Hand pulling**

Hand pulling of aquatic plants is similar to pulling weeds out of a garden. It involves removing entire plants (leaves, stems, and roots) from the area of concern and disposing of them in the trash or an area away from the shoreline, depending on the species. In water less than three feet deep no specialized equipment is required, although a spade, trowel, or long knife may be needed if the sediment is packed or heavy. In deeper water, **hand pulling** is best accomplished **by divers** with SCUBA equipment and mesh bags for the collection of plant fragments. Some sites may not be suitable for hand pulling such as areas where deep, loose flocculent sediments may cause a person hand pulling to sink deeply into the sediment. Other areas where hand pulling may be in effective are rocky areas (such as a rip-rap wall), areas with large amounts of fallen wood, or areas with dense vegetation (such as reed canarygrass) where weed root removal is very difficult.

A sturdy rake makes a useful tool for removing aquatic plants. Attaching a rope to the rake allows removal of a greater area of weeds. **Raking** literally tears plants from the sediment, breaking some plants off and removing some roots as well. Specially designed aquatic plant rakes are available. Rakes can be equipped with floats to allow easier plant and fragment collection. The operator should pull towards the shore because a substantial amount of plant material can be collected in a short distance. Note that roots left in the soil will create new plants.

### **Cutting (using hand tools)**

Cutting differs from hand pulling in that plants are cut and the roots are not removed. Cutting is performed by standing on a dock or on shore and throwing a cutting tool out into the water. A non-mechanical aquatic weed cutter is commercially available. Two single sided, razor sharp stainless steel blades forming a “V” shape are connected to a handle, which is tied to a long rope. The cutter can be thrown about 20 – 30 feet into the water. As the cutter is pulled through the water, it cuts a 48-inch wide swath. Washington State requires that cut plants be removed from the water. The stainless steel blades that form the V are extremely sharp and great care must be taken with this implement. It should be stored in a secure area where children do not have access.

All of the manual control methods create plant fragments. It’s important to remove all fragments from the water to prevent them from re-rooting or drifting onshore. Plants and fragments can be composted or added directly to a garden.

#### **Advantages**

- Manual methods are easy to use around docks and swimming areas.
- The equipment is inexpensive.
- Hand-pulling allows the flexibility to remove undesirable aquatic plants while leaving desirable plants.
- These methods are environmentally safe if done carefully.
- Manual methods don’t require expensive permits, and can be performed on aquatic noxious weeds with Hydraulic Project Approval obtained by reading and following the Pamphlet *HPA Aquatic Plants and Fish* (publication #APF-1-98) available free of charge from the Washington Department of Fish & Wildlife (1998).

#### **Disadvantages**

- Manual methods must include regular scheduled surveys to determine the extent of the remaining weeds and/or the appearance of new plants after eradication has been attained.
- As plants re-grow or fragments re-colonize the cleared area, the treatment may need to be repeated several times each summer.
- Because these methods are labor intensive, they may not be practical for large areas or for thick weed beds.
- Even with the best containment efforts, it is difficult to collect all plant fragments, leading to re-colonization or spread of the infestation.
- Some plants have massive rhizomes, are difficult to remove by hand pulling.
- Pulling weeds and raking stirs up the sediment and makes it difficult to see remaining plants. Sediment re-suspension can also increase nutrient levels in lake water.
- Hand pulling and raking impacts bottom-dwelling animals.
- The V-shaped cutting tool is extremely sharp and can be dangerous to use.

### **Permits**

Permits are required for many types of manual projects in lakes and streams. The Washington State Department of Fish and Wildlife requires a *Hydraulic Project Approval* permit for all activities taking place in the water including hand pulling, raking, and cutting of aquatic plants. The Pamphlet HPA discussed above is free of charge. Large projects and some control methods may require individual HPAs, which do have a fee.

### **Costs**

- Hand-pulling costs up to \$130 for the average waterfront lot for a hired commercial puller.
- A commercial grade weed cutter costs about \$130 with accessories. Weed rakes costs about \$25 to \$125. Diver hand pulling about \$5,000/day for a “long day” with two divers and a boat.

### **Suitability for Bass Lake**

- Manual control of submersed weeds is an excellent treatment while the population remains small. It is also great follow up to any chemical control, since detailed and careful removal of remaining plants is easily done this way. At this point, handpulling should be sufficient to remove all of the remaining Eurasian watermilfoil plants.
- Manual methods may also be vital in combating new infestations of Eurasian watermilfoil in subsequent years.
- Manual methods have the potential for missing Eurasian watermilfoil plants, especially after stirring up sediments.
- Manual methods have the potential for fragmentation, exacerbating the existing Eurasian watermilfoil problem.
- Manual removal of loosestrife has been employed for several reasons with purple loosestrife; roots can be pulled out in loose, mucky soil or excavated in harder soil, killing the plants. In other situations this does not kill the mature perennial plants, but does halt seed production and can contain the infestation at current levels. If done repeatedly over several seasons it may starve the roots and kill the plants.
- Manual removal of seedlings (pulling) of purple loosestrife is much easier than the removal of well-rooted, mature plants. This technique can be used to exhaust the seed bank and supplement other eradication efforts.

## **Mechanical Control Methods (diver dredging, weed rolling, rotovation, harvesting, cutting)**

### **Diver Dredging**

Diver dredging (suction dredging) is a method whereby SCUBA divers use hoses attached to small dredges (often dredges used by miners for mining gold from streams) to suck plant material from the sediment. The purpose of diver dredging is to remove all parts of the plant including the roots. A good operator can accurately remove target plants, like Eurasian watermilfoil, while leaving native species untouched. The suction hose pumps the plant material and the sediments to the surface where they are deposited into a screened basket. The water and sediment are returned back to the water column (if the permit allows this), and the plant material is retained. The turbid water is generally discharged to an area curtained off from the rest of the lake by a silt curtain. The plants are disposed of on shore. Removal rates vary from approximately 0.25 acres per day to one acre per day depending on plant density, sediment type, size of team, and diver efficiency. Diver dredging is more effective in areas where softer sediment allows easy removal of the entire plants, although water turbidity is increased with softer sediments. Harder sediment may require the use of a knife or tool to help loosen sediment from around the roots. In very hard sediments, milfoil plants tend to break off leaving the roots behind and defeating the purpose of diver dredging.

Diver dredging has been used in British Columbia, Washington, and Idaho to remove early infestations of Eurasian watermilfoil (King County, 2003). In a large-scale operation in western Washington, two years of diver dredging reduced the population of milfoil by 80 percent (Silver Lake, Everett).

#### **Advantages**

- Diver dredging can be a very selective technique for removing pioneer colonies of Eurasian watermilfoil.
- Divers can remove plants around docks and in other difficult to reach areas.
- Diver dredging can be used in situations where herbicide use is not an option for aquatic plant management.
- Might be good spot control method in subsequent years (coordinated with diver survey)

#### **Disadvantages**

- Diver dredging is very expensive.
- Dredging stirs up large amounts of sediment. This may lead to the release of nutrients or long-buried toxic materials into the water column.
- Only the tops of plants growing in rocky or hard sediments may be removed, leaving a viable root crown behind to initiate growth.

#### **Permits**

Diver dredging requires Hydraulic Approval from the Department of Fish and Wildlife, and other permits may be required.

#### **Costs**

Depending on the density of the plants, specific equipment used, number of divers and disposal requirements, costs can run about \$3,000 per day.

### **Suitability for Bass Lake**

- Bass Lake is very dark and thus would make diver dredging very hard and not suitable as a control method.

### **Rotovation**

Rotovators use underwater rototiller-like blades to uproot Eurasian watermilfoil plants. The rotating blades churn seven to nine inches deep into the lake or river bottom to dislodge plant root crowns that are generally buoyant. The plants and roots may then be removed from the water using a weed rake attachment to the rototiller head or by harvester or manual collection. Since rotovation causes severe short term turbidity and major fragmentation of both plants and roots, it is not recommended for any but small water bodies where all available area is already occupied by the weeds.

### **Harvesting**

Mechanical harvesters are large machines which both cut and collect aquatic plants. Cut plants are removed from the water by a conveyor belt system and stored on the harvester until disposal. Harvesting machines can cut plants from two to seven feet deep, but can be hindered by docks and submerged wood. A barge may be stationed near the harvesting site for temporary plant storage or the harvester carries the cut weeds to shore. The shore station equipment is usually a shore conveyor that mates to the harvester and lifts the cut plants into a dump truck. Harvested weeds are disposed of in landfills, used as compost, or in reclaiming spent gravel pits or similar sites. Harvesting of submerged weeds is usually done two or more times a growing season. Since harvesting causes major fragmentation of submerged weeds and cannot retrieve all fragments, harvesters often cause the infestation to spread. Therefore, harvesting is not recommended unless an entire water body is infested with the weed and the goal is maintenance of open water using a long term mowing schedule.

### **Cost**

Harvesting costs range from \$1,200 to \$1,500 per acre per treatment.

### **Mechanical Cutting**

Mechanical weed cutters cut aquatic plants several feet below the water's surface. Unlike harvesting, cut plants are not collected while the machinery operates and are left in the water column.

### **Suitability of Rotovation, Harvesting and Cutting for Bass Lake**

None of these options are suitable for the level of infestation at Bass Lake. They are not eradication tools, but rather are used to manage and control heavy, widespread infestations of aquatic weeds. These processes create plant fragments, and therefore should not be used in systems where milfoil is not already widespread. In a moderate infestation of submerged aquatic weeds such as at Bass Lake, these methods would probably serve to spread and expand the infestation. According to Ecology, "There is little or no reduction in plant density with mechanical harvesting." Since the aim of this project is to eliminate milfoil from the system, these are not compatible control strategies. Harvesting and cutting do not remove root systems. Rotovation would cause damage to the lake sediments and associated animals in a system that does not already receive dredging for navigability.

## **Environmental Manipulation (water level drawdown, bottom barriers/screens, nutrient reduction)**

### **Water Level Drawdown**

Lowering the water level of a lake or reservoir can have a dramatic impact on some aquatic weed problems. Water level drawdown can be used where there is a water control structure that allows the managers of lakes or reservoirs to drop the water level in the waterbody for extended periods of time. Water level drawdown often occurs regularly in reservoirs for power generation, flood control, or irrigation; a side benefit being the control of some aquatic plant species. However, regular drawdowns can also make it difficult to establish native aquatic plants for fish, wildlife, and waterfowl habitat in some reservoirs.

### **Suitability for Bass Lake**

Drawdown is not a viable control strategy for Bass Lake. The outlet from Bass Lake is a natural stream through a wetland system that does not have a control structure installed. Not only would drawdown be difficult to achieve, it would also cause significant damage to the ecosystem. The amount of drawdown required to impact milfoil would dry out the littoral zone of the lake. This would damage native plants and animals in both the lake and the adjacent wetland and have many negative consequences for residents living around the lake. Without a regular, strong surface inflow to the system (lake), returning the water level to a previous state would be both cost and time prohibitive.

### **Bottom Screens/Barrier**

A bottom screen or benthic barrier covers the sediment like a blanket, compressing aquatic plants while reducing or blocking light. Materials such as burlap, plastics, perforated black Mylar, and woven synthetics can all be used as bottom screens. Some people report success using pond liner materials. There is also a commercial bottom screen fabric called Texel, a heavy, felt-like polyester material, which is specifically designed for aquatic plant control.

An ideal bottom screen should be durable, heavier than water, reduce or block light, prevent plants from growing into and under the fabric, be easy to install and maintain, and should readily allow gases produced by rotting weeds to escape without “ballooning” the fabric upwards.

Over time algae can accumulate on the bottom screen, resulting in the trapping of gas from below. Even the most porous materials, such as window screen, will billow due to gas buildup. Therefore, it is very important to anchor the bottom barrier securely to the bottom. Unsecured screens can create navigation hazards and are dangerous to swimmers. Anchors must be effective in keeping the material down and must be regularly checked. Natural materials such as rocks or sandbags are preferred as anchors.

The duration of weed control depends on the rate that weeds can grow through or on top of the bottom screen, the rate that new sediment is deposited on the barrier, and the durability and longevity of the material. For example, burlap may rot within two years, plants can grow through window screening material, and can grow on top of felt-like Texel fabric. Regular maintenance is essential and can extend the life of most bottom barriers.

Bottom screens will control most aquatic plants, however freely-floating species such as the bladderworts or coontail will not be controlled by bottom screens. Plants like Eurasian watermilfoil will send out lateral surface shoots and may canopy over the area that has been screened giving less than adequate control.

In addition to controlling nuisance weeds around docks and in swimming beaches, bottom screening has become an important tool to help eradicate and contain early infestations of noxious weeds such as Eurasian watermilfoil and Brazilian elodea. Pioneering colonies that are too extensive to be hand pulled can sometimes be covered with bottom screening material. For these projects, we suggest using burlap with rocks or burlap sandbags for anchors. By the time the material decomposes, the milfoil patches will be dead as long as all plants were completely covered. Snohomish County staff reported native aquatic plants colonizing burlap areas that covered pioneering patches of Eurasian watermilfoil. When using this technique for Eurasian watermilfoil eradication projects, divers should recheck the screen within a few weeks to make sure that all milfoil plants remain covered and that no new fragments have taken root nearby.

Bottom screens can be installed by the homeowner or by a commercial plant control specialist. Installation is easier in winter or early spring when plants have died back. In summer, cutting or hand pulling the plants first will facilitate bottom screen installation. Research has shown that much more gas is produced under bottom screens that are installed over the top of aquatic plants. The less plant material that is present before installing the screen, the more successful the screen will be in staying in place. Bottom screens may also be attached to frames rather than placed directly onto the sediment. The frames may then be moved for control of a larger area (see instructions for constructing and installing bottom screens).

#### **Advantages**

- Installation of a bottom screen creates an immediate open area of water.
- Bottom screens are easily installed around docks and in swimming areas.
- Properly installed bottom screens can control up to 100 percent of aquatic plants.
- Screen materials are readily available and can be installed by homeowners or by divers.

#### **Disadvantages**

- Because bottom screens reduce habitat by covering the sediment, they are suitable only for localized control.
- For safety and performance reasons, bottom screens must be regularly inspected and maintained.
- Harvesters, rotovators, fishing gear, propeller backwash, or boat anchors may damage or dislodge bottom screens.
- Improperly anchored bottom screens may create safety hazards for boaters and swimmers.
- Algae can accumulate on the screen, resulting in gas trapping, and ballooning of the screen.
- Swimmers may be injured by poorly maintained anchors used to pin bottom screens to the sediment.
- Some bottom screens are difficult to anchor on deep muck sediments.
- Bottom screens interfere with fish spawning and bottom-dwelling animals.
- Without regular maintenance aquatic plants may quickly colonize the bottom screen.

#### **Permits**

Bottom screening in Washington requires hydraulic approval, obtained free from the Department of Fish and Wildlife. Check with your local jurisdiction to determine whether a shoreline permit is required.

### **Costs**

Barrier materials cost \$0.22 to \$1.25 per square foot. The cost of some commercial barriers includes an installation fee. Commercial installation costs vary depending on sediment characteristics and type of bottom screen selected. It costs up to about \$750 to have 1,000 square feet of bottom screen installed. Maintenance costs for a waterfront lot are about \$120 each year.

### **Suitability for Bass Lake**

- Most of the lakeshore have only small infestations and the bottom barrier would just reduce habitat by covering the sediment.
- Infested areas are too scattered to use a bottom barrier without becoming cost prohibitive.

## **Biological Control**

### **General Overview**

*The following information and citations on the watermilfoil weevil are taken from the Washington State Department of Ecology's website on Aquatic Plant Management.*  
<http://www.ecy.wa.gov/programs/wq/plants/management/biocontrol.html>

Many problematic aquatic plants in the western United States are non-indigenous species. Plants like Eurasian watermilfoil, Brazilian elodea, and purple loosestrife have been introduced to North America from other continents. Here they grow extremely aggressively, forming monocultures that exclude native aquatic plants and degrade fish and wildlife habitat. Yet, often these same species are not aggressive or invasive in their native range. This may be in part because their populations are kept under control by insects, diseases, or other factors not found in areas new to them.

The biological control of aquatic plants focuses on the selection and introduction of other organisms that have an impact on the growth or reproduction of a target plant, usually from their native ranges. Theoretically, by stocking an infested waterbody or wetland with these organisms, the target plant can be controlled and native plants can recover.

**Classic biological control** uses control agents that are host specific. These organisms attack only the species targeted for control. Generally these biocontrol agents are found in the native range of the nuisance aquatic plants and, like the targeted plant, these biocontrol agents are also non-indigenous species. With classic biological control an exotic species is introduced to control another exotic species. However, extensive research must be conducted before release to ensure that biological control agents are host specific and will not harm the environment in other ways. The authors of *Biological Control of Weeds – A World Catalogue of Agents and Their Target Weeds* state that after 100 years of using biocontrol agents, there are only eight examples, world-wide, of damage to non-target plants, “none of which has caused serious economic or environmental damage...” (Julien, 1982).

Search for a classical biological control agent typically starts in the region of the world that is home to the nuisance aquatic plant. Researchers collect and rear insects and/or pathogens that appear to have an impact on the growth or reproduction of the target species. Those insects/pathogens that appear to be generalists (feeding or impacting other aquatic plant species) are rejected as biological control agents. Insects that impact the target species (or very closely related species) exclusively are considered for release.

Once collected, these insects are reared and tested for host specificity and other parameters. Only extensively researched, host-specific organisms are cleared by the United States for release. It generally takes a number of years of study and specific testing before a biological control agent is approved.

Even with an approved host-specific bio-control agent, control can be difficult to achieve. Some biological control organisms are very successful in controlling exotic species and others are of little value. A number of factors come into play. It is sometimes difficult to establish reproducing populations of a bio-control agent. The ease of collection of the biocontrol and placement on the target species can also have a role in the effectiveness. Climate or other factors may prevent its establishment, with some species not proving capable of over-wintering in their new setting. Sometimes the bio-control insects become prey for native predator species, and sometimes the impact of the insect on the target plant just isn't enough to control the growth and reproduction of the species.

People who work in this field say that the more biological control species that you can put to work on a problem plant, the better success you will have in controlling the targeted species. There are some good examples where numerous biological control agents have had little effect on a targeted species, and other examples where one biocontrol agent was responsible for the complete control of a problem species.

However, even when biological control works, a classic biological control agent generally does not totally eliminate all target plants. A predator-prey cycle establishes where increasing predator populations will reduce the targeted species. In response to decreased food supply (the target plant is the sole food source for the predator), the predator species will decline. The target plant species rebounds due to the decline of the predator species. The cycle continues with the predator populations building in response to an increased food supply.

Although a successful biological control agent rarely eradicates a problem species, it can reduce populations substantially, allowing native species to return. Used in an integrated approach with other control techniques, biological agents can stress target plants making them more susceptible to other control methods.

A number of exotic aquatic species have approved classic biological control agents available for release in the US. These species include Hydrilla, water hyacinth, alligator weed, and purple loosestrife.

In 1992, three beetles were released in Washington for purple loosestrife control. Their damaging impact on purple loosestrife populations was evident in the Winchester Wasteway area of Grant County in 1996. In 1998, 1999, and 2000, the Washington State Noxious Weed Control Board organized insect collection for state, local, and federal staff. Thousands of insects were collected and distributed to purple loosestrife sites throughout the state and even the United States. The King

County Noxious Weed Control Program has placed *Galerucella* sp. from the Winchester Wasteway on a number of purple loosestrife sites. These sites were chosen because of a high density of the target plant and the fact that other control methods were impractical. The sites were in complex wetland habitats with a high presence of native vegetation that would be damaged by chemical applications or repeated foot traffic through the wetland to implement manual control methods.

Another type of biological control uses **general agents** such as grass carp (see below) to manage problem plants. Unlike classical bio-control agents, these fish are not host specific and will not target specific species. Although grass carp do have food preferences, under some circumstances, they can eliminate all submersed vegetation in a waterbody. Like classic biological control agents, grass carp are exotic species and originate from Asia. In Washington, all grass carp must be certified sterile before they can be imported into the state. There are many waterbodies in Washington (mostly smaller sites) where grass carp are being used to control the growth of aquatic plants.

During the past decade a third type of control agent has emerged. In this case, a native insect that feeds and reproduces on northern milfoil (*Myriophyllum sibiricum*) which is native to North America, was found to also utilize the non-native Eurasian watermilfoil (*Myriophyllum spicatum*). Vermont government scientists first noticed that Eurasian watermilfoil had declined in some lakes and brought this to the attention of researchers. It was discovered that a native watermilfoil weevil (*Euhrychiopsis lecontei*) feeding on Eurasian watermilfoil caused the stems to collapse. Because native milfoil has thicker stems than Eurasian watermilfoil, the mining activity of the larvae does not cause it the same kind of damage. A number of declines of Eurasian watermilfoil have been documented around the United States and researchers believe that weevils may be implicated in many of these declines.

Several researchers around the United States (Vermont, Minnesota, Wisconsin, Ohio, & Washington) have been working to determine the suitability of this insect as a bio-control agent. The University of Washington is conducting research into the suitability of the milfoil weevil for the biological control of milfoil in Washington lakes and rivers. Surveys have shown that in Washington the weevil is found more often in eastern Washington lakes and it seems to prefer more alkaline waters. However, it is also present in cooler, wetter western Washington. The most likely candidates for use as biological controls are discussed in the following section.

## **Grass Carp**

*The following information and citations on the watermilfoil weevil are taken from the Washington State Department of Ecology's website on Aquatic Plant Management.*

<http://www.ecy.wa.gov/programs/wq/plants/management/aqua024.html>

The grass carp, also known as the white amur, is a vegetarian fish native to the Amur River in Asia. Because this fish feeds on aquatic plants, it can be used as a biological tool to control nuisance submergent aquatic plant growth.

Success with grass carp in Washington has been variable. Sometimes the same stocking rate results in no control, control, or even complete elimination of all underwater plants. Only 18 percent of 98 Washington lakes stocked with grass carp at a median level of 24 fish per vegetated acre were found to have aquatic plants controlled to an intermediate level. In 39 percent of the lakes, all submersed plant species were eradicated. It has become the consensus among researchers and aquatic plant managers around the country that grass carp are an all or nothing control option.

They should be stocked only in waterbodies where complete elimination of all submersed plant species can be tolerated.

Grass carp exhibit definite food preferences and some aquatic plant species will be consumed more readily than others. Eurasian watermilfoil is one of the less-preferable plants, and the fish will eat most other aquatic plants in the lake before eating it. Generally in Washington, grass carp do not consume emergent wetland vegetation or water lilies even when the waterbody is heavily stocked or over stocked.

#### **Facts about grass carp:**

- Are only distantly related to the undesirable European carp, and share few of its habits.
- Live for at least ten years and probably much longer in Washington waters.
- Will grow rapidly and reach at least ten pounds. They have been known to reach 40 pounds in the southern United States.
- Feed only on plants at the age they are stocked into Washington waters.
- Will not eat fish eggs, young fish or invertebrates, although baby grass carp are omnivorous.
- Feed from the top of the plant down so that mud is not stirred up. However, in ponds and lakes where grass carp have eliminated all submersed vegetation the water becomes turbid. Hungry fish will eat the organic material out of the sediments.
- Have definite taste preferences. Plants like Eurasian milfoil and coontail are not preferred. American waterweed and thin leaved pondweeds are preferred. Water lilies are rarely consumed in Washington waters.
- Are dormant during the winter. Intensive feeding starts when water temperatures reach 68° F.
- Are a river fish and have the desire to move from still waters into flowing waters.
- Are difficult to recapture if a waterbody has been overstocked.
- They may not feed in swimming areas, docks, boating areas, or other sites where there is heavy human activity.

#### **Advantages**

- Grass carp are inexpensive compared to some other control methods and offer long-term control, but fish need to be restocked at intervals.
- Grass carp offer a biological alternative to aquatic plant control.

#### **Disadvantages**

- Depending on plant densities and types, it may take several years to achieve plant control using grass carp and in many cases control may not occur or all submersed plants may be eliminated.
- The type of plants grass carp prefer may also be those most important for habitat and for waterfowl food.
- If the waterbody is overstocked, all submersed aquatic plants may be eliminated. Removing excess fish is difficult and expensive.
- If not enough fish are stocked, less-favored plants, such as Eurasian milfoil, may take over the lake.
- Stocking grass carp may lead to algae blooms.
- All inlets and outlets to the lake or pond must be screened to prevent grass carp from escaping into streams, rivers, or other lakes.

## Permits

For Washington residents, a private fish stocking permit must be obtained from the Washington Department of Fish and Wildlife. Check with your Fish and Wildlife regional office to obtain a permit application. Also, if inlets or outlets need to be screened, an Hydraulic Project Approval application must be completed for the screening project. Grass carp may not be permitted to be stocked in some states.

## Costs

In quantities of 10,000 or more, 8 to 12 inch sterile grass carp can be purchased for about \$5.00 each for truck delivery. The cost of small air freighted orders will vary and is estimated at \$10 to \$20 per fish with shipping.

## Other Considerations

- Would not achieve immediate results – takes time and is not guaranteed to work.
- Community may have concerns with introduced species
- Potential damage to the native plant community of the lake, which could result in the establishment of other aggressive plant species as pioneers
- Concerns from fishermen about grass carp
- Initial investment very expensive
- The introduction of grass carp has generally been discouraged by State agencies.

## Suitability for Bass Lake

- Grass carp are not suitable for aquatic plant control in Bass Lake. The infestation of milfoil has not reached a level where a bio-control such as grass carp would be necessary.
- Their preferred food species include the dominant submersed aquatic species in Bass Lake, which might be grazed before the milfoil. They could remove all the beneficial plants that support a healthy fish population. Without cover and the invertebrates associated with beneficial native aquatic vegetation, the system would be degraded and some species (invertebrates, fish, etc.) may be extirpated.
- The lake also has an outlet stream that eventually flows into other lakes and the Green River making it much more difficult to obtain the permits necessary to stock grass carp.

## Watermilfoil Weevil

*The following information and citations on the watermilfoil weevil are taken from the Washington State Department of Ecology's website on Aquatic Plant Management.*

<http://www.ecy.wa.gov/programs/wq/plants/management/weevil.html>

The milfoil weevil, *Euhrychiopsis lecontei*, has been associated with declines of Eurasian watermilfoil (*Myriophyllum spicatum*) in the United States (e.g. Illinois, Minnesota, Vermont, and Wisconsin). Researchers in Vermont found that the milfoil weevil can negatively impact Eurasian watermilfoil by suppressing the plants growth and reducing its buoyancy (Creed and Sheldon 1995). In 1989, state biologists reported that Eurasian watermilfoil in Brownington Pond, Vermont had declined from approximately 10 hectares (in 1986) to less than 0.5 hectares. Researchers from Middlebury College, Vermont hypothesized that the milfoil weevil, which was present in Brownington Pond, played a role in reducing Eurasian watermilfoil (Creed and Sheldon 1995). During 1990 through 1992, researchers monitored the populations of Eurasian watermilfoil and the milfoil weevil in Brownington Pond. They found that by 1991 Eurasian watermilfoil cover had

increased to approximately 2.5 hectares (approximately 55-65 g/m<sup>2</sup>) and then decreased to about 1 hectare (<15 g/m<sup>2</sup>) in 1992. Weevil abundance began increasing in 1990 and peaked in June of 1992, where 3 - 4 weevils (adults and larvae) per stem were detected (Creed and Sheldon 1995). These results supported the hypothesis that the milfoil weevil played a role in reducing Eurasian watermilfoil in Brownington Pond.

To date, there have not been any documented declines of Eurasian watermilfoil in Washington State that can be attributed to the milfoil weevil, although Creed speculated that declines of Eurasian watermilfoil in Lake Osoyoos and the Okanogan River may have been caused by the milfoil weevil. In Minnesota, Cernaiko Lake is the only lake in that state that has had a Eurasian watermilfoil crash due to the weevil; other weevil lakes are yet to show declines in Eurasian watermilfoil. Researchers in Minnesota have suggested that sunfish predation may be limiting weevil densities in some lakes (Sutter and Newman 1997). The latter may be true for Washington State as sunfish populations are present in many lakes in the state, including those with weevils. In addition, other environmental factors that may be keeping weevil populations in check in Washington, but have yet to be studied, include over-wintering survival and habitat quality and quantity (Jester et. al. 1997; Tamayo et. al., in press). Although the milfoil weevil shows potential as a biological control for Eurasian watermilfoil more work is needed to determine which factors limit weevil densities and what lakes are suitable candidates for weevil treatments in order to implement a cost and control effective program.

### **Advantages**

- Milfoil weevils offer a biological alternative to aquatic plant control.
- They may be cheaper than other control strategies.
- Biocontrols enable weed control in hard-to-access areas and can become selfsupporting in some systems.
- If they are capable of reaching a critical mass, biocontrols can decimate a weed population.

### **Disadvantages**

- There are many uncertainties as to the effectiveness of this biocontrol in western Washington waters.
- There have not been any documented declines of Eurasian watermilfoil in Washington State that can be attributed to the milfoil weevil.
- Many of our lakes, possibly including Bass Lake, have introduced sunfish populations that may predate on the milfoil weevils.
- Bio-controls often don't eradicate the target plant species, and there would be population fluctuations as the milfoil and weevil follow predator-prey cycles.

### **Permits**

The milfoil weevil is native to Washington and is present in a number of lakes and rivers. It is found associated with both native northern milfoil and Eurasian watermilfoil. A company is selling milfoil weevils commercially. However, to import these out-of-state weevils into Washington requires a permit from the Washington Department of Agriculture. As of 2011 no permits have been issued for use of milfoil weevils to control aquatic weeds in Washington State.

### **Suitability for Bass Lake**

Since the milfoil weevil is a new bio-control agent, it has not been released yet intentionally in western Washington to control Eurasian watermilfoil. It is uncertain how effective the weevil will be and whether populations per stem can be maintained at levels high enough to eradicate Eurasian watermilfoil.

Also, as with the grass carp, the infestation of milfoil in Bass Lake is not heavy enough to warrant bio-control introduction when other methods are still available.

## **Purple loosestrife biocontrol agents**

***Galerucella* spp. Beetles** Two species of *Galerucella* beetles were first released in Washington in 1992 and subsequently have been released in King County several times in many locations. These small golden-brown leaf-feeders defoliate plants and attack the terminal bud area, halting or drastically reducing seed production. The larvae feed constantly on the leaf underside. Loosestrife seedling mortality is high. These beetles are highly mobile and are often found in King County in locations far from release sites.

***Hylobius transversovittatus*** is a root-mining weevil that also eats leaves. The adult beetle is reddish brown and ½ inch long. It eats from the leaf margins, working inward. Eggs are laid in the lower 2-3 inches of the stem, or sometimes in the soil near the root. The larvae then work their way to the root, where they eat the carbohydrate reserves. Evidence of larvae in the root is a zig-zag pattern.

## **No Action Alternative**

One option for managing aquatic weeds in Bass Lake is to let aquatic weeds continue to grow, and do nothing to control them. This “no action” alternative would acknowledge the presence of the aquatic weeds but would not outline any management plan or enact any planned control efforts. Effectively, a no action determination would preclude any integrated treatment and/or control effort, placing the choice and responsibility of aquatic weed control with lakefront property owners.

## **Suitability for Bass Lake**

The milfoil infestation is currently low in density; unless control measures are enacted, it is likely to increase each growing season in the future until the entire littoral zone of the lake is dominated by milfoil. Based on results of informal surveys by residents and King County staff, the infestations of milfoil have fluctuated over the year and purple loosestrife was recently discovered. If there is no

control effort, it is likely that weed infestations will continue to grow, deteriorating the diverse and native shoreline Bass Lake currently boasts.

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## **Appendix B – Noxious Weed BMPs**

# Purple Loosestrife

*Lythrum salicaria*  
Lythraceae

**Class B Noxious Weed  
Control Required**

**Legal Status in King County:** Purple loosestrife is a Class B Noxious Weed (non-native species harmful to environmental and economic resources that landowners may be required to control based on distribution in the county and local priorities) according to Washington State Noxious Weed Law, RCW 17.10. In accordance with state law, the King County Noxious Weed Control Board requires property owners to control purple loosestrife on private and public lands throughout the county (control means to prevent all seed production and to prevent the dispersal of all propagative parts capable of forming new plants). In addition, state quarantine laws prohibit transporting, buying, selling, or distributing plants, plant parts or seeds of purple loosestrife.



## BACKGROUND INFORMATION

### Impacts and History

- Purple loosestrife is an invasive and competitive noxious weed that alters wetland ecosystems by replacing native and beneficial plants. Water-dependent mammals and waterfowl and other birds leave wetlands when their food source, nesting material and shelter are displaced by purple loosestrife.
- Dense infestations of purple loosestrife also alter the landscape by trapping sediments and thereby raising the water table.
- Although young shoots of purple loosestrife are palatable to cattle (and to white-tailed deer), larger plants are not, and so cattle graze preferentially on pasture grasses, giving purple loosestrife a distinct advantage in grazed areas. Over time, mature purple loosestrife plants will dominate, removing the use of the land as pasture. Similar processes can lead to destruction of hay meadows. Occasionally, deer browse the tops of mature plants in wetlands, but this doesn't appear to reduce the overall density of purple loosestrife.
- Purple loosestrife was introduced to the United States in the early 1800's at northeastern port cities, in ship ballast obtained from European tidal flats. Over the next 100 years it spread through canals and other waterways as far as the Midwest. It arrived in marine

estuaries in the Pacific Northwest in the early 1900s, suggesting that it was spread by maritime commerce.

- Purple loosestrife has also been commonly cultivated for the horticultural trade and became prized by bee-keepers in the mid 1900s. Deliberate planting and escapes from cultivation undoubtedly aided in the spread of infestations across the country.
- Purple loosestrife was first collected in Washington in 1929 from Lake Washington. The first eastern Washington collection was in the 1940s from the Spokane area, although there are reports that it escaped from a garden to the Spokane River ten years earlier.

## Description

- Perennial emergent aquatic plant, reaching over 9 feet tall and 5 feet wide. As many as 30-50 herbaceous stems annually rise from a persistent perennial tap root and spreading rootstock.
- **Square stems** (usually 4-sided, sometimes 6-sided). Leaves are usually opposite. The leaves are linear in shape, 1.5 to 4 inches long, with smooth edges, and are sometimes covered with fine hairs.
- The showy **magenta or purple flowers appear from July to October** on flowering spikes. The flowers have 5 to 7 greenish sepals, 5 to 7 magenta petals and 12 stamens. Flowers will continue until frost.
- In winter months, dead, brown flower stalks remain with old seed capsules still visible.



## Habitat

- Occurs in freshwater and brackish wetlands, lake and river shorelines, ponds, shallow streams and ditches, wet pastures and other wet places.
- Grows on moist or saturated soils or in shallow water. Can tolerate a range of soil pH and nutrients.
- Requires partial to full sunlight. Productivity is significantly reduced at 40% of full light.

## Reproduction and Spread

- Spreads mainly by seed but also by stem and root fragmentation. A mature plant may have as many as thirty flowering stems capable of producing an estimated two to three million, pepper-sized seeds per year. Most seeds remain viable after two years in a natural water body, and stored in laboratory conditions they are viable for about three years.
- Dispersal is mainly by water, but seeds can also be transported on feathers and fur of waterfowl and other wetland animals as well as in mud on boots, tires, boats and pets. There is also some evidence of wind dispersal.
- Seedling densities sharply fall beyond 34 feet of the parent plant.
- Seed banks build for years, unnoticed until the right conditions of disturbance appear, resulting in a population explosion. Mature plants can live for 20 years.
- Vegetative spread is also possible. Buried stems harbor adventitious buds with the ability to produce shoots or roots. Breaking off stems or roots during incomplete plant removal initiates bud growth. Removed stems left on moist soil will also grow roots and sprout.

## Local Distribution

- Found on lakes and waterways throughout King County, with 1,214 total sites reported in 2010.

## CONTROL INFORMATION

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### Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods that reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and should allow for flexibility in method as appropriate.

### Planning Considerations

- Survey area for weeds, set priorities and select best control method(s) for the site conditions and regulatory compliance issues (**refer to the King County Noxious Weed Regulatory Guidelines or local jurisdictions**).
- Control practices in critical areas should be selected to minimize soil disturbance, or efforts should be taken to mitigate or reduce impacts of disturbance. Any disturbed areas need to be stabilized to control erosion and sediment deposition. Refer to the King County Surface Design Manual for further information about sediment and erosion

control practices (call 206-296-6519 or go to <http://kingcounty.gov/wlr/Dss/Manual.htm> for more information).

- Small infestations can be effectively hand-pulled or dug up if conditions allow (see section on Manual Control for more information). Isolated plants should be carefully removed in order to stop them from infesting a larger area.
- For larger infestations, the strategy will depend on the site. Generally work first in least infested areas, moving towards more heavily infested areas. On rivers, begin at the infestation furthest upriver and work your way downstream.
- Minimize disturbance to avoid creating more opportunities for seed germination.
- Properly dispose of all parts of the plant (see Disposal Methods section below).

## Early Detection and Prevention

- Look for new plants. Get a positive plant identification by contacting your local noxious weed control program or extension service.
- Look for plants along river and lake shorelines, in ponds, wetlands, ditches and wet pastures.
- The best time to survey is in July and August when the plants are flowering; however, seedlings may not flower in the first year.
- Look for seedlings starting in June.
- Dig up or pull small isolated patches.
- Prevent plants spreading from existing infestations by cleaning off equipment, boots, clothing and animals that have been in infested areas.
- Don't buy or plant purple loosestrife. According to state quarantine laws it is illegal to buy, sell or offer purple loosestrife or any of its cultivars for sale.

## Manual

- Hand pulling and the use of hand mechanical tools is allowable in unincorporated King County critical areas. Check with the local jurisdiction for regulations in other areas.
- If the plants are in flower or seed, **cut off and bag all flower stalks and seed heads.** It is very difficult to pull the plants without dispersing the small, lightweight seeds. Brush off boots, clothes and animals before leaving the infested area.
- Hand pulling is recommended when plants are rooted in mucky, sandy or other loose, wet soil. Grasp the base of the plant and pull slowly with steady pressure to release the roots from the soil. Pulling purple loosestrife by hand is easiest when plants are young. Older plants have larger roots that can be eased out with a garden fork. Remove as much of the root system as possible, because broken roots may sprout new plants.



- Cutting plants at the base when in flower may prevent seeding, but cut plants may continue to produce flowers. Sites should be consistently and regularly monitored until frost to cut and remove any subsequent flowers. Cutting will not kill the plants, and they will need to be controlled every year. Do not leave cut plant parts on site, because root and stem fragments can take root and form new plants.
- All manual control sites should be monitored for several years for plants growing from root fragments and from the seed bank.
- **DISPOSAL:** All purple loosestrife plant parts, including flowers, seed heads, stems, leaves and roots must be securely bagged, and discarded in the trash or taken to a transfer station. **Do not compost or place in yard waste. Plants may regenerate in compost. If you have the ability to burn plants, following all local regulations and restrictions, burning vegetative material is an acceptable disposal method. Do not burn flowering stems or seed heads.**
- **NOTE:** Under the Washington State Lythrum quarantine (WAC 16.752.400-415), it is illegal to transport, buy, sell, offer to sell, or to distribute plants, plant parts or seeds of purple loosestrife into or within the state of Washington. However, by following the recommendations in this Best Management Practices document you are covered under the King County Noxious Weed Control Program's permit to transport purple loosestrife for the purpose of taking it to a transfer station or landfill.

## Mechanical

- Removal of purple loosestrife with hand held mechanical tools is allowable in critical areas and their buffers within unincorporated King County. Check with the local jurisdiction for regulations in other areas.
- Mowing is not recommended. Since plant fragments can produce new shoots, mowing may facilitate spread rather than control.
- Cutting alone is not a control option for purple loosestrife. New plants will grow from the roots. Cutting late in the season but before seed set reduces shoot production more than mid-summer cutting.
- Sheet mulching or covering using black plastic, landscape fabric, or cardboard and six inches of mulch is an interim option for dense seedling infestations. It does not kill the roots of mature plants, but it does slow down growth and seed dispersal. The covering must extend several feet beyond the edges of the infestation and be weighted so the plants cannot push it up. The edges of the covered area must be monitored for plants coming up from rhizomes extending beyond the sheet. Covering materials should also be monitored for damage or gaps and repaired or re-installed as needed.

## Chemical

- **Precautions:**
  - Herbicides should only be applied at the rates and for the site conditions and/or land usage specified on the label of the product being used. **Follow all label directions.**
  - For herbicide use in critical areas and their buffers, certain restrictions apply depending on the site and jurisdiction. In unincorporated King County, refer to the **King County Noxious Weed Regulatory Guidelines** for a summary of current

- restrictions and regulatory compliance issues. Elsewhere, check with the local jurisdiction.
- For your personal safety, at a minimum wear gloves, long sleeves, long pants, closed toe shoes, and appropriate eye protection. Follow label directions for any additional personal protection equipment needed.
  - A Washington State pesticide license with an aquatic endorsement is required for the purchase of aquatic herbicides. **NEVER apply non-aquatic herbicide formulations to water since many include ingredients toxic to aquatic organisms.**
  - For large infestations of purple loosestrife, herbicide use may be necessary for effective control.
  - Cutting after spraying is not necessary. If cutting is desired, infested areas should not be cut until after the herbicide has had a chance to work, which may take several weeks.
  - In sensitive areas or areas prone to erosion, careful spot-spraying will create less disturbance than manual or mechanical control.
  - For several years following treatment, monitor areas for new plants germinating from the seed bank. In some cases several years of treatment may be necessary.
  - When treating an area intermixed with native monocots (cattails, grasses, sedges, etc), using a selective broadleaf herbicide is recommended. The monocots will not be harmed by the herbicide and will be able to help suppress new plants emerging from the seed bank.

### **Specific Herbicide Information**

**Glyphosate** (e.g. Rodeo®, AquaMaster® or Aqua Neat®): Apply to actively growing plants at early flowering stage. Application to pre-flowering plants or seedlings may also be effective, but unless the extent of the infestation is well known, plants can be difficult to locate when not in flower. Glyphosate works slowly, so plants may not appear to be affected for a couple of weeks. A second application a few weeks after the first may be helpful to control plants not in flower or otherwise skipped during the first application. Apply to foliage but avoid runoff. Caution: Glyphosate is non-selective and it will injure or kill other vegetation contacted by the spray including grasses, cattails and other monocots.

**Imazapyr** (Habitat®, Polaris®): Apply to foliage any time the plant is actively growing. Caution: Imazapyr is non-selective and highly effective even at low doses: it will injure or kill other vegetation contacted by the spray including trees, desirable vegetation, and grasses, cattails and other monocots. Also, imazapyr is soil-active and can harm trees and other plants rooted in the spray area or sometimes immediately downhill from the area being sprayed.

**Triclopyr** (Garlon 3A® and Renovate 3®). Apply when plants are in the mid to full-bloom stage. Application to pre-flowering plants or seedlings may also be effective, but unless the extent of the infestation is well known, plants can be difficult to locate when not in flower. Triclopyr is a selective herbicide and will kill only dicots (broadleaf plants and trees). It will not harm monocots such as grasses, sedges, cattails and many native aquatic plants.

All the above listed herbicides require the addition of an approved surfactant. Follow label directions for selecting the correct type of surfactant. Be sure that the selected surfactant is approved for aquatic use in Washington State.

*The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product.* Chemical control options may differ for private, commercial and government agency users. **For questions about herbicide use, contact the King County Noxious Weed Control Program at 206-296-0290.**

## Biological

- Biological control can take up to six years to have a significant impact on the infestation. Purple loosestrife population density and the number of flowering plants can be reduced, but there will always be some plants remaining when using biological control agents. Releases should be made only at sites where loosestrife infestations are large and immediate eradication of the weed is not the primary objective.
- All biological control agents approved for use on purple loosestrife in Washington State will not feed on any plant species other than purple loosestrife in our area.
- Where feasible, biological control plans should incorporate another non-chemical control method to be able to prevent all seed production as required by state law. If the infestation is inaccessible, remove flowers at the edges of the infestation to the greatest extent possible. If *Galerucella* or *Hylobius* species are present, flower heads should be cut, bagged and properly disposed of by the time of flower drop in mid to late August. If *Nanophyes marmoratus* weevils are present, flower/seedheads should be cut very carefully in early September after emerging adult weevils have left the flowerheads for the season. If there is any chance of mature seeds being present in the seed heads, extreme care should be taken to avoid spread.

- Biological control is not recommended or prescribed for small infestations.
- Two species of *Galerucella* beetles were first released in Washington in 1992 and subsequently have been released in King County several times in many locations. These small golden-brown leaf-feeders defoliate plants and attack the terminal bud area, halting or drastically reducing seed production. The larvae feed constantly on the leaf underside. Loosestrife seedling mortality is high. These beetles are highly mobile and are often found in King County in locations far from release sites. *Galerucella* beetles do not do well near salt water.
- *Hylobius transversovittatus* is a root-mining weevil that also eats leaves. The adult beetle is reddish brown and ½ inch long. It eats from the leaf margins, working



*Galerucella* beetles feeding on purple loosestrife



*Hylobius transversovittatus*

inward. Eggs are laid in the lower 2-3 inches of the stem, or sometimes in the soil near the root. The larvae then work their way to the root, where they eat the carbohydrate reserves. Evidence of larvae in the root is a zig-zag pattern. *Hylobius* tolerates coastal areas and is a better choice for infestations near salt water.

- *Nanophyes marmoratus* is a tiny seed weevil. Larvae and adults impact purple loosestrife by feeding on unopened flower buds. Flower buds with larval feeding damage usually abort and fail to produce seeds. Adults also feed on developing leaves, further weakening plants. *Nanophyes* can also be successful when used in conjunction with *Hylobius*.



*Nanophyes* weevil on purple loosestrife

## SUMMARY OF BEST MANAGEMENT PRACTICES

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### **Small Infestations in Native and/or Desirable Vegetation**

- Hand pulling is recommended for young plants or older plants in loose, wet soil.
- Larger plants from isolated small populations can be dug out from moist upland areas. This may be impractical to impossible when trying to remove hardy, woody roots in compacted soils. Care should be taken to minimize erosion when digging in saturated soils on shorelines.
- If the plants are in flower or in seed, **cut off and bag all flower heads**. Pulling plants in seed will disperse the small, lightweight seeds. Cut plants may continue to produce flowers, so these sites will have to be consistently and regularly monitored until frost to cut and remove any subsequent flowers.
- When digging or pulling on shorelines, take appropriate erosion control measures.
- If manual control is not possible due to site conditions or available labor, apply appropriate herbicide with wick wiper or spot spray to minimize off target injury.
- If using an herbicide in an area that has desirable grasses and other monocots, use a selective broadleaf herbicide to avoid injury to grasses and other monocots.

### **Large Infestations in Areas with Monocots**

- Cutting alone is not a control option for purple loosestrife. Shoots and adventitious roots will develop. Cutting late in the season but before seed set reduces shoot production more than mid-summer cutting. Cut plants may continue to produce flowers, so these sites will have to be consistently and regularly monitored until frost to cut and remove any subsequent flowers.
- Sheet mulching using black plastic, landscape fabric, or cardboard and six inches of mulch is an interim option for dense seedling infestations. It does not kill the roots of mature plants, but it does slow down growth and seed dispersal. This method is also non-selective.
- If an area has desirable monocots present, use a selective herbicide and encourage the growth of the monocots.

- If the infestation is in a pasture, encourage healthy grassy areas by seeding and fertilizing. Use a mix of grass and clover species to improve resistance to purple loosestrife. Fertilize according to the soil needs.
- If using biological control, areas need to be monitored and any flowers removed and properly disposed of where feasible. If the infestation is inaccessible, remove flowers around the edges of the infestation to the greatest extent possible. If *Galerucella* or *Hylobius* insects are present, flower heads should be cut, bagged and properly disposed of by the time of flower drop in mid to late August. If *Nanophyes marmoratus* weevils are present, flower/seedheads should be cut very carefully in early September after emerging adult weevils have left the flowerheads for the season. If there is any chance of mature seeds being present in the seed heads, extreme care should be taken to avoid spread.

### **Control on Shorelines**

- When large areas of weeds are removed, the cleared area needs to be replanted with native or non-invasive vegetation and stabilized against erosion. Refer to the King County Surface Design Manual for further information about sediment and erosion control practices (call 206-296-6519 or go to <http://kingcounty.gov/wlr/Dss/Manual.htm> for more information).
- Survey area and document extent of infestation.
- Focus on manual removal for small infestations if possible.
- When removing vegetation on shorelines (by lakes, streams and wetlands) use barriers to prevent sediment and vegetative debris from entering the water system.
- Cutting will not control purple loosestrife but it can serve in the interim until more effective control measures can be accomplished.
- For larger areas where herbicide use is warranted, spray using low pressure and large droplet size to reduce drift. If herbicide could potentially drift into the water or a wetland area, use only approved aquatic herbicides and surfactants after obtaining the necessary permits.
- Infested areas will need to be monitored for several years to control plants growing from root fragments and germinating from the extensive seed bank.

### **Control along Road Rights-of-Way**

- Pull small infestations if possible.
- Spot spray larger infestations. Use a selective broadleaf herbicide in areas with desirable monocots such as grasses, sedges or cattails; if controlled with a non-selective herbicide, re-seed after control is completed.
- If plants are about to flower, they can be cut until a more effective control strategy can be used. Be sure to dispose of cut plant parts properly.
- If plants are sprayed, wait until the herbicide has had a chance to work before conducting any regular right-of-way mowing.

## Disposal Methods

- All purple loosestrife plant parts, including flowers, seed heads, stems, leaves and roots must be securely bagged, and discarded in the trash or taken to a transfer station. **Do not compost or place in yard waste. Plants may regenerate in compost. If you have the ability to burn plants, following all local regulations and restrictions, burning vegetative material is an acceptable disposal method. Do not burn flowering stems or seed heads.**
- **NOTE:** Under the Washington State Lythrum quarantine (WAC 16.752.400-415), it is illegal to transport, buy, sell, offer to sell, or to distribute plants, plant parts or seeds of purple loosestrife into or within the state of Washington. However, by following the recommendations in this Best Management Practices document you are covered under the King County Noxious Weed Control Program's permit to transport purple loosestrife for the purpose of taking it to a transfer station or landfill.

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## Eurasian Watermilfoil

*Myriophyllum spicatum*

Class B Non-Regulated Noxious Weed  
Control Recommended

## Variable-leaf Milfoil

*Myriophyllum heterophyllum*

Class A Noxious Weed  
Control Required

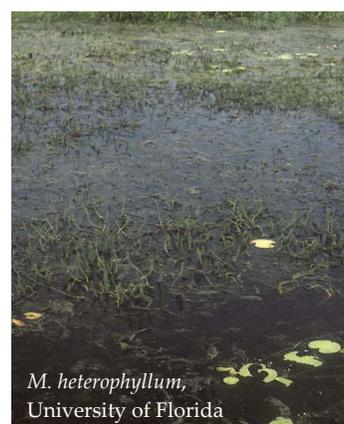
### Haloragaceae

**Legal Status in King County:** Variable-leaf milfoil is a Class A Noxious Weed according to Washington State Noxious Weed Law, RCW 17.10 (non-native species that is harmful to environmental and economic resources and that landowners are required to eradicate). In accordance with state law, the King County Noxious Weed Control Board requires property owners to eradicate variable-leaf milfoil from private and public lands throughout the county (eradicate means to eliminate a noxious weed within an area of infestation). Eurasian watermilfoil is a Class B Non-Regulated Noxious Weed (non-native species that can be designated for control based on local priorities). The State Weed Board has not designated this species for control in King County. The King County Weed Control Board recommends control of Eurasian watermilfoil where feasible, but does not require it. State quarantine laws prohibit transporting, buying, selling, or distributing plants, plant parts or seeds of these milfoils.

## BACKGROUND INFORMATION

### Impacts and History

- Eurasian watermilfoil is native to Eurasia but is widespread in the United States, including Washington. In King County it is present in numerous lakes and slow moving streams and rivers.
- Variable-leaf milfoil is native to the eastern United States. It was introduced to southwestern British Columbia several decades ago and was confirmed in Thurston and Pierce Counties in 2007.
- Both of these plants are very aggressive and can outcompete native aquatic plants, forming dense



monotypic stands. They can reduce biodiversity, change the predator/prey relationships in a lake and adversely impact the food web.

- These milfoil species impact recreation by eliminating swimming opportunities, fouling boat motors and snagging fishing lines.
- When allowed to grow in dense stands and “top out”, the floating mats or emergent flower stems prevent wind mixing, and extensive areas of low oxygen can develop during the summer.
- Stagnant mats create mosquito breeding areas and increase the water temperature underneath by absorbing sunlight.
- These plants die back in the fall, and the resulting decay uses up dissolved oxygen and adds nutrients to the water, potentially increasing algae growth and related water quality problems.



## Description, Reproduction and Spread

Milfoil species (*Myriophyllum* spp.) can be very difficult to tell apart, particularly when not in flower. Not only can the vegetative structures look very similar, but Eurasian watermilfoil (*M. spicatum*) is known to cross with the native northern milfoil (*M. sibiricum*), creating an invasive hybrid. Anyone who finds a new, aggressive population of milfoil should consult an expert to get a positive identification before taking action to control it.

### Eurasian watermilfoil (*Myriophyllum spicatum*)

- Perennial, rhizomatous plant grows in water to 20 feet (possibly up to 30 feet) deep.
- Forms tangled underwater stands and dense floating mats.
- Leaves are in whorls of four, and are feathery, with generally more than 14 leaflet pairs per leaf. Leaves often appear squared-off at the tip. Leaves usually collapse against the stem when the plant is pulled from the water.
- Stems are long, branched near the surface, and usually reddish.
- Flowers are tiny and borne on reddish spikes above the water surface.
- Spread is generally by plant fragments or rhizomes.



- Can be confused with the native northern milfoil (*Myriophyllum sibiricum*), which generally has fewer than 14 leaflet pairs per leaf. The native milfoils also tend to retain their shape when pulled from the water rather than collapsing against the stem.



### **Variable-leaf milfoil (*Myriophyllum heterophyllum*)**

- Perennial, rhizomatous plant grows in water to 15 feet deep.
- Forms tangled underwater stands and dense floating mats.
- Submersed leaves are in whorls of four to six, and are feathery, with six to 14 leaflet pairs per leaf.
- Flowering spikes emerge up to six inches above the water and have bright green, leaf-like bracts that are in whorls of 4 to 6 with toothed to entire margins.
- Flowers are tiny and borne in the axils of the leaf-like bracts.
- Submersed stems are stout (up to 8 mm in diameter), reddish, often with numerous branches. A cross-section of the stem will reveal “pie-shaped” air chambers.
- Spread is by plant fragments, rhizomes and seed.
- Has the ability to produce terrestrial plants with leaves resistant to drying. These apparently do not colonize new areas, but aid in the survival of the species in years when the water level is unusually low.
- Can be confused with the native western milfoil (*M. hippuroides*), which also has emergent flower stems with leaf-like bracts, and vegetative plants can be confused with the native northern milfoil (*Myriophyllum sibiricum*), which also has fewer than 14 leaflet pairs per leaf.

### **Habitat**

- Milfoils grow in still and slow moving water, generally up to about 20 feet deep for Eurasian watermilfoil, and six to 15 for variable-leaf milfoil, depending on water clarity.
- They tend to cluster at downwind ends of smaller water bodies or in quiet coves where fragments can settle out of the water column and take root.
- Both tolerate a wide range of pH.
- Eurasian watermilfoil can tolerate brackish water.

## Local Distribution

- Eurasian watermilfoil is widespread in western Washington and in King County, with established populations in the large lakes (Lakes Washington, Sammamish and Union), the Sammamish River, and a number of smaller lakes (notably Green Lake in Seattle).
- Variable-leaf milfoil was discovered in a lake in Thurston County in 2007, the first confirmed record in Washington State. It has since been found in another lake in Thurston County, as well as in two lakes in Pierce County (Blue and Clear Lakes), all four of which are privately owned. Since it is particularly difficult to distinguish from the native western milfoil (*M. hippuroides*), it may be established in other areas as well. The Washington State Department of Ecology is investigating other potential populations. At this writing, there are no confirmed populations of variable-leaf milfoil in King County.

## CONTROL INFORMATION

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### Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods which reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and should allow for flexibility in method as appropriate.

### Planning Considerations

- Survey area for weeds, set priorities and select best control method(s) for the site conditions and regulatory compliance issues (refer to the King County Noxious Weed Regulatory Guidelines).
- Small infestations may be effectively removed using manual methods or hand tools.
- Milfoil spreads by fragmentation, so care must be taken to contain and remove all plant fragments when using manual or mechanical control methods. Otherwise, the infestation will spread.
- Any control actions taken will necessarily affect all landowners adjacent to the water body and will require their approval and participation in order to succeed. In addition, many control options will be expensive and it will be more cost-effective to pool resources.
- Commit to monitoring. Once initial control has been achieved, be sure to conduct follow up monitoring and control in subsequent years in order to catch any overlooked patches or returning infestations before they can spread. Without this, control efforts can be wiped out within a few years. Monitor the site each year for at least three years after last observing any milfoil, and then again after three years.
- Any water body with a public boat launch should be monitored regularly since milfoils can be re-introduced easily from plant fragments on a boat or trailer.

## Permitting and Regulatory Requirements

- Permits are required for all weed control work in natural water bodies.
- At minimum, the pamphlet **Aquatic Plants and Fish** is required. This pamphlet is published by the Washington State Department of Fish and Wildlife and acts as a Hydraulic Project Approval (HPA) permit. It is available free of charge online at <http://wdfw.wa.gov/hab/aquaplnt/aquaplnt.htm> or by calling (360) 902-2534. This “pamphlet HPA” is all you will need for most manual or light mechanical control methods.
- More extensive control, including some bottom barrier placement and all herbicide use, will require additional permits from Washington State. See the sections below for details.
- Permits and licenses are required for all herbicide use in aquatic systems. Minimum requirements include a pesticide applicator’s license with an aquatic endorsement from the Washington Department of Agriculture and a permit from the Washington Department of Ecology.
- Some incorporated cities also regulate any work conducted in natural waterbodies. Contact your local jurisdiction for details.
- **Permit requirements can change from year to year. Contact the King County Noxious Weed Control Program for more information on current permitting requirements.**

## Early Detection and Prevention

- Look for new plants. Get a positive plant identification from an authority such as King County Noxious Weed Control Program staff.
- Look for plants along lake shorelines and in stagnant or slow-moving water in wetlands and streams. Since these plants are often spread as fragments attached to boat motors and trailers, check especially around boat launches. Also check at the downwind end of the waterbody, and anywhere else where fragments could congregate or settle out of the water column.
- The best time to begin surveys is late spring when plants are visible, and surveys can continue into early fall when the plants senesce (die back).
- Clean all plant material off of boats, motors and trailers, and check bilgewater for plant fragments any time you have been in an infested water body (or a potentially infested water body).
- **Never dispose of unwanted aquarium or water garden plants or animals in a natural water body.** Variable-leaf milfoil in particular is still sold in some areas as an aquarium plant, and may have been introduced to Washington waters by careless dumping of aquariums.

## Manual Control

- At minimum, an HPA pamphlet permit is required for all manual control activities in natural waterbodies. In incorporated areas, check with your local jurisdiction for other possible permit requirements.

- Hand pulling and the use of hand mechanical tools is allowable in all critical areas in unincorporated King County.
- Hand pulling can be successful for a very small area but is impractical for large infestations. Be sure to contain and remove all plants and plant fragments from the water.
- Weed rakes and weed cutters can assist in maintaining open water in a discrete area, such as around a dock, but will not eliminate the plants. Be sure to contain and remove all plants and plant fragments from the water.
- All manual control sites should be monitored for several years for signs of plants growing from roots or fragments.
- **DISPOSAL:** Milfoils can be composted on land away from water or placed in yard waste bins. Do not leave any plant parts or fragments in the water or near the water's edge. Variable-leaf milfoil can grow on exposed soil during periods of low water, so extra care should be taken to dispose of it away from the water.

### **Mechanical Control**

- At minimum, an HPA pamphlet permit is required for all mechanical control activities in natural waterbodies. In incorporated areas, check with your local jurisdiction for other possible permit requirements.
- Cutting and harvesting using boat-mounted cutters or in-lake harvesting barges is effective at maintaining open water in water bodies with 100% of the available habitat infested. It must be done on a regular basis to maintain control. However, these methods will quickly spread these plants by creating numerous fragments, so cutting and harvesting are not recommended for small or partial infestations. Neither method will eradicate an infestation. In unincorporated King County, only an HPA pamphlet permit is required for cutting and harvesting noxious weeds.
- Diver dredging using boat or barge mounted suction dredges can be effective for small infestations or as a follow-up to herbicide treatment. Special care must be taken to remove all fragments. This method causes a temporary increase in turbidity and requires specific authorization from the Washington Department of Fish and Wildlife (WDFW).
- Rotovation (underwater rototilling) is not recommended since it causes severe fragmentation of the plants. Rotovation also results in significant short term turbidity and loss of water clarity and quality, as well as destruction of benthic habitat. Rotovation requires an individual HPA permit.

### **Cultural Methods**

- An opaque bottom barrier can be used to suppress growth in small, discrete areas like at a boat launch or around a swimming area. Barriers need to be regularly cleaned because plants will root in the sediment that accumulates on top of them. This is not practical for large-scale infestations. Bottom barriers in Lake Washington and Lake Sammamish are not allowed without prior authorization by the Washington Department of Fish and Wildlife (WDFW) due to potential impact on sockeye salmon

spawning areas. A pamphlet HPA at minimum is required for bottom barrier installation. Other permits may also be required.

- Waterbodies with control structures can sometimes use water level drawdown to control submerged weeds. Generally the bottom must be exposed to heat or cold long enough to dry out completely, something that can be difficult to achieve in rainy western Washington. Occasionally drawdowns can backfire and increase subsequent germination of weed seeds, especially with variable-leaf milfoil. Drawdowns can have major impacts on native plants and other aquatic organisms. Carefully weigh the pros and cons before deciding on this option. A drawdown is not covered by the pamphlet HPA. Consult your local WDFW office for permit information.

## Chemical Control

- Permits and licenses are required for all chemical control in water.
- Herbicides may be the most reasonable option for eradication of large submerged noxious weed infestations. Professional licensed contractors are available for hire to perform this task.
- Herbicides can only be applied to aquatic systems in Washington State by a licensed pesticide applicator. Aquatic formulations of herbicides are not available for sale over the counter to anyone without an aquatic pesticide license. **NEVER apply non-aquatic herbicide formulations to water since most of them include ingredients that are toxic to aquatic organisms.**
- Multiple years of treatment may be required to eradicate a milfoil infestation. For several years following treatment, monitor areas for new plants germinating from the seed bank. Remove any new growth using one of the manual control methods above.

## Specific Herbicide Information

Milfoil species are dicots, and therefore selective herbicides can be used to control them with minimal collateral damage to the primarily monocot native plant communities. 2,4-D, a selective herbicide, and fluridone, a non-selective herbicide, have both been used to control Eurasian watermilfoil to good effect in western Washington lakes. However, 2,4-D cannot be used in waterbodies that support salmonids (salmon and trout species). Triclopyr, another selective herbicide, has been approved for control of submerged plants as of 2008 and shows promise as an alternative herbicide for milfoil control. Endothall and diquat, which are both contact herbicides, will control existing vegetation, but will not kill the roots, so the control is temporary.

*The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product.* Chemical control options may differ for private, commercial and government agency users. **For questions about herbicide use, contact the King County Noxious Weed Control Program at 206-296-0290.**

## Biological

- Triploid grass carp have been tried as a control for milfoil species, but milfoil is not palatable to them, and they will generally eat everything else in the waterbody first. Grass carp are not allowed in water bodies where the inlet and outlet cannot be screened to prevent fish from leaving the waterbody. Grass carp are not allowed anywhere in the Lake Washington and Lake Sammamish system. They are not recommended as a control for milfoil, although they can be used if these species predominate. Care should be taken to evaluate potential impacts on the native plant community before choosing grass carp as a control method.
- In some situations, the native milfoil weevil (*Euhrychiopsis lecontei*) seems to control Eurasian watermilfoil. The weevil appears to prefer Eurasian watermilfoil over its native host, northern watermilfoil (*Myriophyllum sibiricum*), and in lakes where the weevil occurs naturally, Eurasian milfoil has been shown to be less of a problem. Ongoing research is exploring lake conditions in which the weevil may thrive, including water pH and the abundance of insect-eating fish. Although no permits are needed to use native insects as biocontrol, currently the weevils are difficult to obtain in quantities high enough to have an effect on milfoil populations. Even when they have been specially reared and introduced, it can take several years for populations in a waterbody to reach sufficient levels to control milfoil populations. Biocontrols of any type will not eradicate milfoil, but if effective should reduce a milfoil population to below the threshold of significant impact.

## SUMMARY OF BEST MANAGEMENT PRACTICES

- At all times at minimum a pamphlet HPA permit is required to do any activity that disturbs a lake bottom or wetland or streambed. For more extensive work, more specific permits will be required.
- Hand pulling or digging is recommended for small populations, with extreme care taken not to let fragments spread.
- Where a population has filled every possible inch of habitat in a waterbody and its connected waterways, cutting or harvesting when done consistently can maintain open water and diminish the adverse affects of these species.
- Bottom barriers can maintain small areas of open water around boat launches, swimming areas or docks, as long as care is taken to keep them free of debris and fragments.
- Diver dredging can be effective for small infestations or as a follow-up to herbicide treatment.
- To eradicate large areas of milfoil, herbicides are probably the best option.
- **Do not apply any herbicide to water without the proper licenses.** Hire a contractor to do the work.

## **Control in small isolated or man-made ponds**

- Permits may be required (see “Permitting and Regulatory Requirements” section above).
- Drawdown can be very effective. Remove all plants and plant fragments. Let the bed dry out completely before refilling. Thoroughly clean pond liners. Examine or discard ornamental plants that may harbor plant fragments before re-introducing them to the pond.
- Manual control will work if the infestation is caught early and all fragments are removed.
- Bottom barriers may be effective over natural pond beds.
- Follow recommendations above for chemical control.

## **Control in small lakes**

- Permits will be required for all control work (see “Permitting and Regulatory Requirements” section above).
- Community involvement will be essential for successful control efforts.
- For small pioneering infestations, manual control or bottom barriers may be effective. Monitor the lake for fragments and additional infestation sites. Maintain bottom barriers to prevent sediment buildup.
- For large or whole-lake infestations, chemical control will be the most effective (see above for chemical recommendations). Mechanical control may be used to manage infestations, but will not eradicate the weeds. Bottom barriers, if properly maintained, will create open water in small areas.

## **Control in flowing water (rivers, streams, ditches)**

- Permits will be required for all control work (see “Permitting and Regulatory Requirements” section above).
- The most effective control will start with the furthest upstream infestation and move downward. If there are any weeds left upstream, any cleared site will likely be re-infested.
- If possible, contain the area being controlled with a boom to catch fragments before they float downstream.
- Manual control may be the most practical. Bottom barriers need to be securely anchored.
- Chemical control in flowing water is difficult. Consult an expert before considering this option.

## **Control along shores of Lakes Washington and Sammamish**

- Permits will be required for all control work (see “Permitting and Regulatory Requirements” section above).
- Eradication of submerged aquatic weeds from these waterbodies is not practical.
- Bottom barriers, if properly maintained, can provide open water around docks, marinas, swimming beaches, and similar areas. Prior authorization by the Washington

Department of Fish and Wildlife (WDFW) is required due to potential impact on sockeye salmon spawning areas.

- Manual control of small patches may be sufficient.
- Mechanical control can be effective for lakeside communities or large marinas. Be sure to remove all fragments from the water.
- Spot control using chemicals can be effective in the right conditions. It is possible that more than one species of submerged noxious weeds may be present (particularly Brazilian elodea, which is increasing in these lakes). If this is the case, be sure to select an herbicide that will control all targeted weeds (consult BMPs for each weed or ask an expert for assistance in selecting herbicides). If there is any significant wave action or current, the chemicals will drift off target or quickly become diluted. Consult with a professional contractor before choosing this option. Neighboring property owners should be advised prior to spot chemical applications.
- Grass carp are not allowed in the Lake Washington and Lake Sammamish system.

### **Disposal Methods**

- Eurasian watermilfoil can be left on land to dry out and/or decompose where it will not move into a waterway.
- Variable-leaf milfoil should not be left on the bank since it may root in damp soil.
- Both milfoils can be composted or placed in yard waste bins.

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**King County**

Department of  
Natural Resources and Parks  
Water and Land Resources Division

**Noxious Weed Control Program**

## BEST MANAGEMENT PRACTICES

### Invasive Knotweeds

**Bohemian Knotweed, Japanese Knotweed,  
Giant Knotweed, Himalayan Knotweed**

*Polygonum bohemicum, P. cuspidatum,  
P. sachalinense, P. polystachyum*  
Polygonaceae

### Class B Noxious Weed; Not Designed for Control

**Legal Status in King County:** Class B non-designated noxious weed (non-native species listed on the Washington State Weed List, but already widespread in this area). The King County Noxious Weed Control Board recommends, but does not require, property owners to control and prevent the spread of invasive knotweeds on public and private lands throughout the county. State quarantine laws prohibit transporting, buying, selling or offering invasive knotweed for sale or distributing plants, plant parts or seeds.

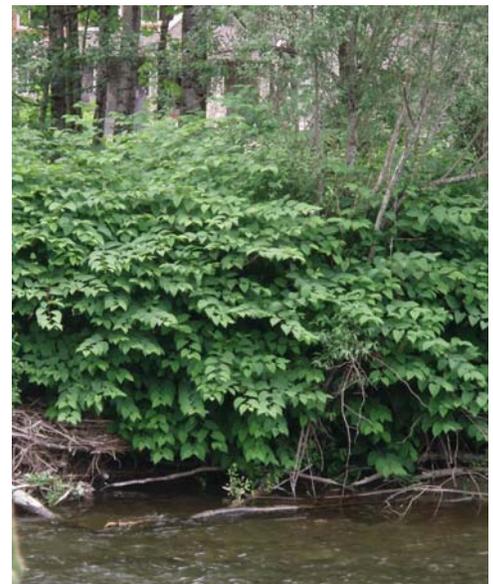


## BACKGROUND INFORMATION

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### Impacts and History

- Displaces native vegetation due to its aggressive growth.
- Creates bank erosion problems and is considered a potential flood hazard. Despite knotweed's large rhizome mass, it provides poor erosion control.
- Lowers quality of riparian habitat for fish and wildlife.
- Thickets can completely clog small waterways.
- Forms dense stands that crowd out all other vegetation, degrading native plant and animal habitat.
- Difficult to control because of extremely vigorous rhizomes that form a deep, dense mat.
- Plants can resprout from stem or root fragments; plant parts that fall into the water can create new infestations downstream.
- Japanese and giant knotweeds are native to northeastern Asia. Giant and Japanese knotweeds hybridize to produce Bohemian knotweed. Himalayan knotweed is native to south and central Asia, including the Himalayas.
- Introduced in the U.S. in the late 1800s as ornamental plants and for erosion control.



Bohemian knotweed on the Cedar River

## Description

- Large, clump-forming, herbaceous perennial with 4 to 12 feet tall, round canes with thin, papery sheaths and creeping roots. The hollow stems are jointed and swollen at the nodes, giving a bamboo-like appearance.
- Japanese, giant, Bohemian and Himalayan knotweed are members of the buckwheat family (Polygonaceae).
- Rhizomes can spread at least 23 feet (7 meters) from the parent plant and can penetrate more than 7 feet (2 meters) into the soil.
- Forms large, dense clones of either male or female plants.
- Stems are thick and hollow, resembling bamboo, green to reddish in color, often red-speckled. Young shoots look similar to red asparagus.
- Leaves are alternate, bright green with smooth edges. Leaf shape ranges from an elongate triangle (Himalayan knotweed), through rounded with a flat base (Japanese knotweed), somewhat heart-shaped (Bohemian knotweed) to huge, “elephant ear” type leaves (giant knotweed). Hybrids blur these distinctions. Leaf size may vary, however they are generally 4 to 6 inches long by 3 to 4 inches wide on Japanese knotweed and 7 to 9 inches long on hybrid Bohemian knotweed. Giant knotweed leaves often exceed 12 inches across, twice the size of Japanese knotweed leaves.
- Flowers are small, white/green on Japanese, Bohemian and giant knotweed and light pinkish-white on Himalayan knotweed and grow in showy plume-like branched clusters. Flowers form in July and August and grow in dense clusters from the leaf joints. Flowers are either all female (form seeds) or all male (don't form seeds) on each plant.
- Flowers in late July, typically start to form seeds by mid-August.

## Habitat

- Can grow in partial shade or full sun.
- Knotweed thrives in any moist soil or river cobble, but can also grow in dry areas
- Most commonly found in the flood zone along rivers and creeks, it also grows in roadside ditches, railroad rights-of-way, unmanaged lands, wetlands, neglected gardens, and other moist areas.

## Reproduction and Spread

- Knotweed typically starts growth in April, but can begin as late as June in higher elevations.
- Reproduces by seed and vegetatively from rhizomes and roots. Knotweed can spread rapidly due to its ability to reproduce vegetatively.
- Invasive knotweeds spread mainly by rhizomes. Rhizome and root fragments are dispersed by natural causes (flood, erosion) or man-made dispersal (roadside clearing, fill dirt).
- Root fragments, as small as ½ in (1 cm) can form new plant colonies and can also be spread in contaminated fill material.
- Cut or broken stems will sprout if left on moist soil or put directly into water, or if moved by beavers or earth-moving equipment. Each node on the plant stock is able to produce roots and new plants.

- Seeds can be viable for as long as 15 years. Seeds in the upper 1 inch (2 cm) of soil generally are viable for 4 to 5 years. Below 1 inch (2 cm), the seeds remain dormant longer. However, knotweed seedlings are not often found in the wild and most dispersal is by root and stem fragments.
- Knotweed canes die back with the first hard frost (Pridham and Bing 1975) and go dormant during the winter. The dead, brown stems may remain standing through the winter with new canes developing in the spring from the same rootstock.

## Local Distribution

Found throughout King County. The heaviest concentrations of invasive knotweeds are found along riparian corridors and road rights-of-way. Infestations can also be found in residential gardens, wetlands, and upland areas.

# CONTROL INFORMATION

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## Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods that reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and should allow for flexibility in method as appropriate.

## Planning Considerations

- Survey area for weeds, set priorities and select best control method(s) for the site conditions and regulatory compliance issues (**refer to the King County Noxious Weed Regulatory Guidelines**).
- Specific suggestions are given in the Best Management section.
- It is possible, but not easy, to control knotweed, especially on a landscape scale.
- Because of knotweed's incredibly extensive root system and sprouting ability, landscape level control requires long-term planning and follow-up.
- Because the plant spreads easily downstream by water, it is necessary to begin control from the furthest upstream infestation, including all tributaries and other upstream sources of possible re-infestation.
- Even on a patch-by-patch basis, successful eradication is likely to take several years and multiple treatments.
- Although there are potentially successful mechanical or manual control options for small patches, landscape level projects and large sites will likely require integrating herbicide into the control strategy.

- Outreach to all public and private landowners and the broader community, as well as volunteer recruitment and coordination, will improve the success of large landscape scale projects.
- Work with volunteers and other organizations in the community to expand the ability to physically get the work done.
- Landscape level projects may have a greater chance of success under a coordinated effort such as a Cooperative Weed Management Area (CWMA).
- Grants are available for invasive vegetation removal, such as knotweed, that benefits public resources, especially for work done through non-profit organizations or government agencies.

## Early Detection and Prevention

- Monitor for new populations in May and June.
- Dig up isolated or small populations (50 stems or less). If there are more stems than you can remove manually, it may be necessary to treat the area with an appropriate herbicide in the late summer/early fall.
- Prevent plants from spreading away from existing populations by washing vehicles, machinery, and equipment that have been in infested areas.
- Prevent knotweed from entering waterways.
- Do not discard stems or root fragments in waterways or on moist soil.

## Manual or Mechanical Control

- **When to use manual methods:** If there is easy access to the site and patches are reasonably small (50 stems or less), commit to following an intensive control regimen.
- **Variations:** Cutting, mowing, pulling, digging, covering.
- Cutting, mowing and pulling stimulates shoot growth and depletes the roots. The more shoots there are per linear foot of root, the more likely it will be to physically pull out the roots, exhaust them by depriving them of energy (i.e. by cutting the shoot off) or eradicating them with an herbicide treatment.
- When controlling knotweed manually, be sure to practice the four T's: timely, tenacious, tough and thorough (Soll 2004).
- Hand pulling and the use of hand mechanical tools to control noxious weeds are generally allowable in critical areas in unincorporated King County (refer to the **King County Noxious Weed Regulatory Guidelines** for details).
- Be aware that repeated cutting tends to produce numerous small stems that may make future treatment with stem injection more difficult.
- **CUT** stems close to the ground **TWICE A MONTH OR MORE** between April and August, and then once a month or more until the first frost, over 3 to 5 consecutive years (Soll 2004).
  - Try to keep plants from growing taller than 6 inches.
  - Using a machete, loppers or pruning shears, cut the stems to the ground surface. Using a mower/weed-eater, cut as low as possible and as often as possible. Be sure not to scatter stems or root fragments.
  - Rake and pile up the cut stems where they will dry out because stems or stem fragments can sprout, and the area (or adjacent areas) may become re-infested.

- Goats are reported to eat knotweed and in some circumstances, controlled goat grazing may be an option similar to intensive mowing. Be aware that goats will eat desirable vegetation as well as knotweed.
  - Do not allow cut, mowed or pulled vegetation to enter waterways.
- **DIG** up as much root as possible in August over at least three consecutive years; reported to work for small, isolated patches.
  - Each time you see new sprouts (start looking a week after you pull), uproot them as well, trying to pull out as much of the root as you can each time.
  - Be sure to carefully dry or dispose of the roots. Do not put them in a compost pile.
  - Be sure to search at least 20 feet (7 meters) away from the original patch center.
- **COVER** with heavy duty geo-textile fabric or black plastic.
  - Works better with isolated and smaller patches on open terrain.
  - Plan to leave the covering material in place throughout three to five growing seasons.
  - First, cut stems down to ground surface. Next, cover the area with geo-textile fabric or heavy duty black plastic extending beyond the plant base and stems at least 7 feet beyond the outside stems. Leave covering material loose and clean of debris, weighted down with heavy rocks or cement blocks. Watch for holes in the fabric and at the perimeters for any new growth. Every two to four weeks during the growing season, stomp down re-growth under covering material and clean debris.
  - Try this method at the beginning of the year or after cutting the plant down several times during the growing season which will reduce some of the rapid plant growth.

## Chemical

- Herbicides should only be applied at the rates and for the site conditions and/or land usage specified on the label. **Follow all label directions.**
- For your personal safety, at a minimum, wear gloves, long sleeves and pants, closed toe shoes, and appropriate eye protection. Follow label directions for any additional personal protection equipment needed.
- For herbicide use in critical areas and their buffers, certain restrictions apply depending on the site and jurisdiction. In unincorporated King County, refer to the **King County Noxious Weed Regulatory Guidelines** for a summary of current restrictions and regulatory compliance issues. Elsewhere, check with the local jurisdiction.
- **Variations:** foliar spray, wick wipe, cut and pour, or stem injection.
- Herbicides with the active ingredient glyphosate (Rodeo, Aquamaster, AquaNeat, among others), dicamba (Banvel, Clarity, among others), and imazapyr (Habitat, Arsenal) have shown to be variably effective in controlling knotweed either separately or in combination. Each offers benefits and potential risks.
- **Non-selective herbicide, injection method (glyphosate):** can effectively control knotweed. Currently only glyphosate products are labeled for the injection method. Aquamaster/Rodeo/AquaNeat, (aquatic formulations of glyphosate) can be used on or near aquatic sites while Roundup Pro, a non-aquatic formulation, can be used on terrestrial sites.
- **Non-selective herbicides, foliar applications (such as glyphosate, imazapyr)** are most effective when used in combination at a 2% - 1% ratio (2% glyphosate, 1% imazapyr). Glyphosate translocates to roots and rhizomes of perennial weeds and has no apparent soil

activity, while imazapyr is readily absorbed through foliage and roots and can be applied pre-emergent or post-emergent.

- **Selective Broadleaf Herbicides (such as dicamba)** may be more appropriate for knotweed patches adjacent to grass fields or in lawns. Dicamba is a growth regulating broadleaf herbicide, dicamba is readily absorbed and translocated from either roots or foliage. Do not apply to areas where roots of desirable species are growing.

## **Description of Chemical Control Methods**

### **Foliar Application**

- Backpack sprayer or large volume sprayer.
- Easiest and fastest method, risk of drift onto desirable vegetation and into water and soil.
- Use a systemic herbicide which translocates from leaves to the roots.
- Non-selective herbicides, such as glyphosate (Roundup) will harm all actively growing plants if leaves are sprayed. Selective broadleaf herbicides will not harm grasses.

### **Timing**

The right time to apply herbicides is greatly affected by herbicide choice. According to Oregon Department of Agriculture literature, the ideal time to spray most deep-rooted perennials is when they are in bud to early flowering stage. However, because knotweed may be 15 feet tall when it begins to flower (July or August in the Pacific Northwest (PNW)), this is not always practical. Also, spraying taller plants means creating more risk of pesticide drift and older plants may not be as efficient in chemical translocation.

The best time, from a practical standpoint, is when the patches are 3 to 6 feet (1-2 m) tall. Although shorter plants may not have adequate leaf surface to absorb, and translocate, enough chemical to be effective, young, rapidly growing plants do have a more efficient biological process to translocate chemicals. A spring herbicide application or cutting will set back the plant so that it can be sprayed at an effective height and growth stage later in the year. Plants controlled later in the season can be cut to 5 ft in height immediately before spraying, although control effectiveness is somewhat reduced. TNC field data analysis suggest treatment done in April or May is not as effective as those done in June or July.

Regardless of herbicide choice, rate or spray timing, large, established patches (hundreds or thousands of stems) will almost certainly require foliar treatments over two or more years. Similar to treating patches mechanically, be sure to search for new shoots up to 20 feet or more away from the central patch after herbicide treatment begins (Soll 2004).

### **Specific Herbicide Information**

Glyphosate: 2% to 5 % solution.

- Apply as coarse spray with complete, uniform coverage.
- Apply when knotweed is actively growing and most have reached the bud to early flowering stage until the first hard frost.
- Aquamaster/Rodeo plus surfactant (LI-700, Competitor, Agridex) are approved for aquatic sites.

- Roundup Pro (has surfactant mixed in) can be used on terrestrial sites.

Imazapyr : slow-acting and expensive but effective. Can be used alone or in combination with glyphosate.

- 1% solution with 0.25% surfactant or 0.5 to 1 lb per acre.
- Apply from midsummer after seed set until first killing frost.
- Habitat – approved for aquatic sites.
- Arsenal – approved for non-aquatic sites (see label for crop rotation and other restrictions).

Dicamba: 0.25 lb active ingredient with 1 gal water per 400 sq ft.

- Cut plants in June and then apply dicamba to regrowth in late August.
- Apply as basal spray to stems at ground level.
- For upland applications only.

### **Wick Wipe**

- Use an applicator wand with a sponge on the end of a reservoir for the herbicide. Wipe the sponge soaked with herbicide on the leaves and stem of the plants.
- Use glyphosate at 33 to 75 % concentration.
- Greatly reduces drift.
- Hard to get chemical on leaf surface and seems to increase personal contact with herbicide.

### **Cut and Pour**

- Good for small patches and greatly reduces drift.
- Cut stems between lowest 2 nodes.
- Put 3 ml undiluted (concentrated) glyphosate into stem cavity (can use a large needle with measured reservoir to be precise).
- Be very careful not to splash herbicide onto the ground.
- Follow label directions on amount applied per acre (i.e. for the 7.5 quart per acre label rate, can only treat 2375 stems per acre at 3 ml per stem).
- Timing best in late summer or early fall.
- Need to remove cut stems away from water where they can dry out and not spread off site.

### **Stem-Injection**

- Use stem injection gun or similar tool.
- Follow directions carefully especially on calibrating and cleaning the equipment.
- Highly effective; 90% or more controlled in first year.
- Greatly reduces drift and is highly selective.
- No cut stems to deal with.
- Need to inject every cane in the stand; very time and labor intensive compared with foliar spraying.
- Can only inject stems over ½ inch in diameter so there will always be small stems that can't be injected in a population, especially in the second year of treatment.

- Inject 3 ml into each stem between first and second nodes from the ground, or between second and third node if cane is too woody lower down.
- Glyphosate is the only product labeled for injection method, and at 3 ml per cane, can only inject approximately 2375 canes per acre (label maximum is 7.5 quarts per acre).
- Timing best from early July to end of September.

### **Combination of Methods**

- Using a combination of methods can increase efficacy.
- **Cut/Spray:** Cutting stems, followed by foliar spray 3 to 4 weeks later, instead of spraying twice, will reduce overall herbicide input into the watershed and is probably more labor efficient (can use volunteers or unlicensed crews to cut the infestation).
- **Bend/Spray:** This method is highly effective. Bend stems and then approximately 3 to 4 weeks later, spray site. Can use volunteers or unlicensed crews to bend the stems prior to foliar application.
- **Cut/Cover:** This method is moderately effective. Needs constant monitoring and controlling of plants around perimeter and scattered plants that grow through sheet mulch through holes/overlap areas. Every two to four weeks need to stomp down re-growth under covering material and clean off debris.
- **Spray/Spray:** Spring or summer spray followed by fall foliar spray; sets plants back so they can be sprayed at the appropriate growth stage and at the best (easiest) height. This method increases the amount of overall herbicide input into the watershed but takes the least time of all the methods other than spraying once.

*The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product. Chemical control options may differ for private, commercial and government agency users. For questions about herbicide use, contact the King County Noxious Weed Control Program at 206-296-0290.*

### **Biological**

- Biological control is the deliberate introduction of insects, mammals or other organisms which adversely affect the target weed species. Biological control is generally most effective when used in conjunction with other control techniques.
- Research is underway for possible biological control agents that have been identified in the knotweed's native range. However, there are currently no biological control agents available for managing invasive knotweed.

## **SUMMARY OF BEST MANAGEMENT PRACTICES**

### **Small Infestations in Native and/or Desirable Vegetation**

- Dig up plants by hand if soil is wet.
- Apply appropriate herbicide with wick wiper or by spot spray to minimize off target injury.
- Monitor site throughout growing season and remove any new plants. Remember to search at least 25 feet from the original infestation.

- If using an herbicide in a grassy area, use a selective herbicide to avoid injury to the grass or use a wick wiper or stem injector.

## **Large Infestations/Monocultures**

- Mowing is not effective for controlling invasive knotweed infestations.
- Large infestations can be controlled with herbicides. (See the Chemical section of this BMP).
- Eradication of knotweed with a single herbicide application is difficult. Typically it takes several treatments, over 4 to 5 years to get an infestation under control.
- Be sure to monitor for invasive knotweeds on edges of sheet-mulched sites, at overlapped areas in the sheet-mulch, where sheet-mulch has been staked, and around edges of chemically treated areas.

## **Control in Riparian Areas**

- Additional permits may be required for control of infestations in riparian areas. See Noxious Weed Regulatory Guidelines for more information ([http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Noxious Weeds Regulatory Guidelines.pdf](http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Noxious_Weeds_Regulatory_Guidelines.pdf)).
- When large areas of weeds are removed, the cleared area needs to be replanted with native or non-invasive vegetation and stabilized against erosion. Refer to the King County Surface Water Design Manual for further information about sediment and erosion control practices (call 206-296-6519 or go to <http://dnr.metrokc.gov/wlr/Dss/Manual.htm> for information).
- Survey area and document extent of infestation from the headwaters of waterways down.
- Focus on manual removal for small (less than 50 stems) infestations if possible.
- Target the knotweed, retain all native and beneficial plants.
- Inject plants directly adjacent to waterways with glyphosate.
- For larger areas where herbicide use is warranted, apply with a wick wiper or spot spray using low pressure and large droplet size.
- Use aquatic formulations if there is any risk of herbicide entering the water.
- Infested areas will need to incorporate a management plan lasting at least several years to control plants re-sprouting from the rhizome mass, skipped plants and any regrowth.
- Mowing will not control invasive knotweed species, but it can serve as the first step in a combination approach to control.

## **Control on Road Rights-of-Way**

- Dig up small infestations if possible.
- Spot spray with appropriate herbicides.
- Mowing is not an effective means of control and can spread knotweed infestations along road rights-of-way, but it can serve as the first step in a combination approach to control.

## **Knotweed Disposal Methods**

- Knotweed crowns and rhizomes should be collected and discarded with the trash or taken to a transfer station for disposal. Composting crowns and rhizomes is not recommended.
- Knotweed stems can be composted, but they will root on moist soil so they need to be completely dried out before composting.

- Stems can be left on site to dry out and decompose if they are in a dry area where they will not move into waterways or onto moist soil. The area should be monitored for re-growth and stems should not be moved to an un-infested area.
- Dried out stems may be broken up or chipped into pieces less than an inch long and then composted on site, disposed of in a city-provided yard waste container or in the green recycling at a transfer station.
- Stems of knotweed with seeds should be collected and put in the trash or taken to a transfer station. If removal is not feasible, these stems can be left on site. However, there is a risk of spread from the seeds, so the area should be monitored for several years for seedlings. Stems should be left well away from waterways, shorelines, roads and un-infested areas.
- Never dispose of knotweed plants or plant parts into waterways, wetlands, or other wet sites where they might take root.

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# Reed Canarygrass

*Phalaris arundinacea*

Grass Family

## Non-regulated Noxious Weed: Control Recommended

### Identification Tips

- Large, coarse perennial wetland grass that grows 3 to 9 feet tall
- Hairless stems with gradually tapering leaf blades
- Leaves are flat and have a rough texture on both sides and are at a 45-degree angle to stem
- Flower heads are found in narrow clusters on the stems high above the leaves
- Leaves are bright green (compared with the bluish-green leaves of phragmites)
- Grows mostly in wet places or along creeks and lakes

### Biology

- Spreads by seeds and vegetatively by rhizomes that produce a thick mat of stems
- Frost tolerant; one of the first grasses to sprout in the spring
- Vegetative growth peaks in mid-June and declines in mid-August; goes dormant in the winter with visible dead stalks

### Impacts

- Can cause indigestion or illness in livestock
- Displaces native plants due its aggressive, dense root system; wetland species diversity declines drastically
- Increases flooding
- Rhizomes accumulate sediment and clog small streams and drainages
- Dense colonies can form a physical barrier to migrating salmon

### Distribution

- Very common in King County; found in wet pastures, ditches, wetlands and shorelines
- Establishes easily in wet areas with sun, but also can grow on dry soils in upland habitats in part shade (however cannot tolerate full shade)

### Questions?

King County Noxious Weed Control  
Program Line: 206-296-0290  
[www.kingcounty.gov/weeds](http://www.kingcounty.gov/weeds)



*Look for new shoots to start growing very early in the spring; seedheads (right) form May to mid-June.*



*Reed canarygrass spreads quickly and out-competes desirable grasses.*

## What You Can Do

While there is no legal requirement for controlling reed canarygrass, the King County Noxious Weed Control Board recognizes that this species is invasive, creating a damaging impact on the environment and resources of King County. The Board encourages control and containment of existing populations, especially for restoration projects or revegetation plans.



*Removal of well-established infestations of reed canarygrass takes a lot of labor, dedication and planning.*

## Control Methods

Most control methods need to be applied over a number of years to be successful.

**Prevention:** First make sure to identify reed canarygrass correctly. There are several similar looking ornamental and pasture grasses not considered noxious and northwest native grasses that grow in the same habitat, so identification can be difficult. Watch for new patches of reed canarygrass and control them early to prevent future problems. This weed does not grow well in dense shade, so the best long-term solution is to establish a tree and shrub canopy. Evergreens work well for this as they provide year-round shade; native willows also works well. Additional control methods should be used while the shade canopy is developing.

**Manual:** Hand pulling or digging is only practical for small patches. Make sure to remove the entire root mass. Small infestations that are up from the shoreline (stems not underwater) can be controlled by tarping with heavy duty black plastic or non-woven geotextile fabric. However, this method will not completely eliminate the infestation, only reduce the density.

**Mechanical:** If the stems are not underwater and access is possible, mowing may be a viable control method as it removes seed heads. This might be enough to allow surrounding vegetation to move in, although it is unlikely to completely eliminate the reed canarygrass.

**Chemical:** Larger patches most likely will need herbicide treatments to be effective which will likely require a permit issued by the state Department of Ecology if the site is wet or along the water's edge. Feel free to contact us for permitting information or information on hiring a licensed aquatic weed contractor. Using an aquatic formulation of glyphosate (such as Aquamaster, Aquaneat and other products) or imazapyr (such as Habitat) will be most effective in the summer or early fall. Mowing first and allowing the reed canarygrass to grow back to a few feet tall can increase the effectiveness of herbicide spraying. Established populations will usually require at least 2 to 3 years of follow-up treatment and several herbicide applications may be necessary to inhibit seed bank recolonization.

August 2011



**King County**

Department of Natural Resources and Parks  
Water and Land Resources Division  
**Noxious Weed Control Program**  
206-296-0290 TTY Relay: 711



## King County

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## Best Management Practices Sulfur Cinquefoil - *Potentilla recta* Roseaceae

### Class B Noxious Weed



**Legal Status in King County: Class B Noxious Weed** (non-native species designated for control by State Law RCW 17.10 and by the King County Noxious Weed Control Board). **The King County Noxious Weed Control Board requires property owners to control and prevent the spread of sulfur cinquefoil on private and public lands throughout the county. Control is defined by state law as the prevention of all seed production.**

## BACKGROUND INFORMATION

### Impacts and History

- Has invaded habitats ranging from low to high elevation, from seasonal wet meadows to shrubland and forest ecosystems and does not appear to be limited by soil type.
- Able to invade rangeland areas that are in good condition and not being over-grazed.
- Can significantly reduce the forage value of a pasture or rangeland and is one of the last plants to be grazed by animals.
- Even without over-grazing, it can out-compete grasses and other plants.
- Although most often found in disturbed areas, it has also begun to invade native plant communities that are relatively undisturbed by human activities including open canopy forests, forest openings and logged forests in the western United States.
- Originally from central Europe, Asia and the Middle East.
- Appeared in North America sometime before 1900.
- By 1950, sulfur cinquefoil was well established in the eastern U.S. and Canada and starting to spread west. The weed was first reported in Washington in 1937 and was reported from 12 counties in the state by 1996.
- Its rapid spread is similar to that of spotted knapweed and leafy spurge even though it was introduced several decades later.



## Description

- Perennial with a woody rootstock producing one to several erect stems, 1 to 3 feet in height. Stout, hairy, leafy stems are un-branched up to the flowers.
  - Flowers have five butter-colored or light yellow, heart-shaped petals surrounding a darker yellow center.
  - Leaves have stiff hairs and are palmately lobed with five to seven long leaflets that are uniformly toothed along the edges.
- Seeds are tiny, dark brown with prominent branched ridges and narrow winged margins.
  - Plants typically have a deep taproot surrounded by shallow, spreading branch roots.

## Habitat

- Adapted to a wide range of conditions but typically found in grasslands, shrubby areas, logged areas, roadsides, abandoned fields and open forests.
- Found in King County in open grassy areas and with shrubs such as Scotch broom, along railroads and roads, in pastures and abandoned fields.
- Can take advantage of poor soils and disturbed sites but is also successful in moist fields and can out-compete healthy pasture grasses.

## Reproduction and Spread

- Regenerates annually from new shoots emerging from the edges of the root mass. Typically **flowers from early June through July** with **seeds beginning to form in mid to late July**. Reproduces by seed but can spread by roots if moved by mechanical equipment.
- Able to produce many flowers and seeds in early stages of succession. Small infestations with only a few scattered plants can rapidly increase in size and density.
- Stems that are knocked to the ground can produce roots at the nodes. Plants that are cut down will produce new shoots from the rootstock.
- Seeds can live 4 or more years in the soil.

## Local Distribution

There are sulfur cinquefoil infestations in most of the cities and rural areas of the county, from Milton to Woodinville and Skykomish, on city, county and state roadsides and on private properties. Most of the sites are in the east part of the county although there are some in the more urban areas. Infestations range in size from small to large, well-established infestations.

# CONTROL INFORMATION

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## Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods which reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and should allow for flexibility in method as appropriate.

## Planning Considerations

- Survey area for weeds, set priorities and select best control method(s) for the site conditions and regulatory compliance issues (**refer to the King County Noxious Weed Regulatory Guidelines**).
- Small infestations can be effectively dug up. Isolated plants should be carefully removed in order to stop them from infesting a larger area. Be sure to remove as much root as possible.
- For larger infestations, the strategy will depend on the land use of the site. In pastures, good grazing practices and management of grass and forage species will greatly improve control of sulfur cinquefoil. Specific suggestions are given in the Best Management section.
- Generally work first in least infested areas moving towards more heavily infested areas.
- Minimize disturbance to avoid creating more opportunities for seed germination.

## Early Detection and Prevention

- Sulfur cinquefoil is difficult to spot in tall grass unless it is in flower. Survey pasture areas, unmanaged grasslands, roadsides and railroad rights-of-way for flowering and pre-flowering plants from **late May to late June**.
- Dig up isolated or small populations. The site should be monitored over several years for plants growing from any root fragments and from the seed bank.
- Prevent plants from spreading away from existing populations by washing vehicles, boots and animals that have been in infested areas. Seeds are small and are easily carried in mud and in animal fur.
- If animals are being moved from an infested pasture to an uninfested pasture, first hold them for at least five days so that the seeds pass out of the animals' digestive system.

## Manual

- **Dig up plants in the spring or early summer when the soil is still moist and before the seeds mature.** Typically this is from early June through July. The roots are deep and extensive. Plants will re-sprout from root fragments. Remove as much root as possible.
- If plants are in seed, carefully bag and cut off the seed heads before digging up the rest of the plant. It is very difficult to pull the plants without dispersing the small, lightweight seeds. Brush off boots and clothes before leaving the infested area.

- In areas where mature plants are pulled, there are usually many seedlings and seeds left in the soil. Carefully search the area for seedlings and dig them up. Roots break off easily and re-sprout with new plants, so use a digging tool.
- Return to the same location in the following spring and summer to remove plants coming up from seeds already in the soil and continue to monitor the area for several years.
- Hand pulling and the use of hand mechanical tools is allowable in all critical areas in unincorporated King County.

## Mechanical

- Mowing, will **not** control sulfur cinquefoil effectively. Plants have massive, woody root system that store considerable food reserves and mowed plants will send up new shoots after mowing.
- Mowed plants respond by becoming lower growing, more branched, and with more bulky, spreading roots. Plants can still re-sprout, flower and set seed in the same season they are mowed. If you do mow, be sure to clean mowers to prevent spreading seeds to uninfested areas.
- A single plowing may increase sulfur cinquefoil cover, however, on productive agricultural sites, an intensive management program that combines cultivation and annual crops will effectively control sulfur cinquefoil.

## Chemical

- Herbicides should only be applied at the rates and for the site conditions and/or land usage specified on the label. **Follow all label directions.**
- Herbicides may be used in accordance with Federal and State Law in critical areas and their buffers with certain restrictions. Refer to the **King County Noxious Weed Regulatory Guidelines** for a summary of current restrictions and regulatory compliance issues.
- For control of large infestations on roadsides and other areas, herbicide use may be necessary. Infested areas should not be mowed until after the herbicide has had a chance to work and the green vegetation is brown and has died back.
- For several years following treatment, monitor areas for new plants germinating from the seed bank.

## Specific Herbicide Information

**Glyphosate:** Currently, there isn't any information on the effectiveness or timing for glyphosate treatments (e.g. Roundup). The plant's ability to grow and flower into the late summer and even early fall suggests that glyphosate with a good surfactant could be effective for late summer or early fall applications. Treatment with glyphosate needs to be combined with effective re-vegetation of the site to prevent sulfur cinquefoil seedlings from re-infesting the area.

**Selective Broadleaf Herbicides:** (such as triclopyr, 2,4-D and dicamba): Treatment with selective herbicides is most effective in the spring or early summer. Fall applications can be somewhat effective because of the tendency of sulfur cinquefoil to "green up" when the rains return in the fall. **NOTE:** Restrictions apply for products containing 2,4-D and triclopyr BEE (e.g. Curtail,

Amine 4, Weed-B-Gon, Garlon 4, Crossbow) refer to **King County Noxious Weed Regulatory Guidelines** for further details.

- Dicamba combined with 2,4-D Amine is effective on rosettes and seedlings in the spring and much less effective on mature and flowering plants. Products with a combination of dicamba and 2,4-D Amine include Weedmaster, Veteran 720 and Weed-B-Gon Concentrate. Banvel (dicamba) can be combined with 2,4-D Amine but Banvel alone does not provide satisfactory control.
- 2,4-D Ester is effective on the rosette to the bud (pre-flowering) stages.
- Metsulfuron (found in Ally, Escort and other products) is somewhat effective at higher rates but can injure grasses. Metsulfuron can be applied at the flowering stage but may be less than 50% effective.
- Examples of rates that have been effective on sulfur cinquefoil are: Banvel at 1 pint per acre plus 2,4-D Amine at 1 quart per acre; 2,4-D Ester at 2 quarts per acre; and Ally at 0.8 ounce per acre.

*The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product.* Chemical control options may differ for private, commercial and government agency users. **For questions about herbicide use, contact the King County Noxious Weed Control Program at 206-296-0290.**

### **Biological**

- There are no biological control agents currently available for sulfur cinquefoil.

## **Summary of Best Management Practices**

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### **Small Infestations in Native and/or Desirable Vegetation**

- Carefully dig up the plants being sure to get all of the root.
- Replace any turf damaged when removing the plants to lessen the amount of disturbed soil.
- Apply appropriate herbicide with wick wiper or by spot spray to minimize off target injury.
- Monitor site throughout growing season and remove any new plants.
- If using an herbicide in a grassy area, use a selective herbicide to avoid injury to the grass.

### **Large Infestations in Grassy Areas**

- Mowing is not effective for controlling sulfur cinquefoil. Mowing can be used if the infestation is found later in the year to keep the plants from flowering until an approved control method can be used. Do not mow sulfur cinquefoil that has gone to seed.
- Large infestations can be controlled with selective herbicides. (See the Chemical section of this BMP).

- Suppression of large infestations of sulfur cinquefoil with a selective herbicide will greatly increase grass production, which in turn increases the suppression of sulfur cinquefoil.
- Promote healthy grassy areas by seeding and fertilizing. Use a mix of grass and clover species to improve resistance to sulfur cinquefoil. Fertilize according to the soil needs.
- If grassy area is used for grazing, the area should be managed to promote grass and clover vigor. Graze uniformly and move animals from area to area in a planned sequence. Avoid grazing when soil is very wet because holes can be opened up to new weed infestations. Some winter grazing by smaller animals can stimulate growth of clover and improve grass health.
- Continually monitor area - especially disturbed places - for sulfur cinquefoil. Remove isolated plants before they flower.
- If needed, apply a nitrogen fertilizer after the selective herbicide application and then manage grazing so that 4 to 6 inches of grass re-growth remains at the end of the growing season so that grasses can effectively resist re-invasion by sulfur cinquefoil.
- Overgrazing will allow for rapid spread of sulfur cinquefoil in pasture areas. Only goats have been known to graze sulfur cinquefoil. Other livestock will avoid sulfur cinquefoil unless it is the only forage available.

### **Control in Riparian Areas**

- Survey area and document extent of infestation.
- Focus on manual removal for small infestations if possible.
- Mowing will not control sulfur cinquefoil but it can serve in the interim until more effective control measures can be utilized.
- For larger areas where herbicide use is warranted, apply with a wick wiper or spot spray using low pressure and large droplet size.
- When large areas of weeds are removed, the cleared area needs to be replanted with native or non-invasive vegetation and stabilized against erosion.
- If a non-selective herbicide is used in grassy areas, the area needs to be re-seeded to prevent reinvasion by weeds.
- Infested areas will need to incorporate a management plan lasting for several years to control plants germinating from the seed bank.

### **Control Along Road Rights-Of-Way**

- Dig up small infestations if possible.
- Spot spray with glyphosate if weeds are in areas with no desirable vegetation.
- If plants are in grassy areas, use a selective broadleaf herbicide; if controlled with a non-selective herbicide, re-seed after control is completed.
- If plants are about to flower, they can be mowed until a more effective control strategy can be used.

## References

- Biology and Management of Noxious Rangeland Weeds. 1992. Oregon State University Press.
- Pacific Northwest Weed Management Handbook. 2006. Oregon State University.
- PNW Extension Bulletin 376. 1991. Sulfur cinquefoil
- Montana State University Extension Bulletin 109. Sulfur cinquefoil biology, ecology and management in pasture and rangeland.
- Washington State Noxious Weed Control Board. 1994, 1998. Written Findings.

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## **Appendix C - Herbicide Labels**

## ATTENTION:

This specimen label is provided for general information only.

- This pesticide product may not yet be available or approved for sale or use in your area.
- It is your responsibility to follow all Federal, state and local laws and regulations regarding the use of pesticides.
- Before using any pesticide, be sure the intended use is approved in your state or locality.
- Your state or locality may require additional precautions and instructions for use of this product that are not included here.
- Monsanto does not guarantee the completeness or accuracy of this specimen label. The information found in this label may differ from the information found on the product label. You must have the EPA approved labeling with you at the time of use and must read and follow all label directions.
- You should not base any use of a similar product on the precautions, instructions for use or other information you find here.
- Always follow the precautions and instructions for use on the label of the pesticide you are using.

2119514-25



### Complete Directions for Use in Aquatic and Other Non-crop Sites.

AVOID CONTACT OF HERBICIDE WITH FOLIAGE, STEMS, EXPOSED NON-WOODY ROOTS OR FRUIT OF CROPS, DESIRABLE PLANTS AND TREES, BECAUSE SEVERE INJURY OR DESTRUCTION MAY RESULT.

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Read the entire label before using this product.

Use only according to label instructions.

Not all products listed on this label are registered for use in California. Check the registration status of each product in California before using.

Read the "LIMIT OF WARRANTY AND LIABILITY" statement at the end of the label before buying or using. If terms are not acceptable, return at once unopened.

THIS IS AN END-USE PRODUCT. MONSANTO DOES NOT INTEND AND HAS NOT REGISTERED IT FOR REFORMULATION (OR REPACKAGING). SEE INDIVIDUAL CONTAINER LABEL FOR REPACKAGING LIMITATIONS.

#### PRODUCT INFORMATION

### 1.0 INGREDIENTS

#### ACTIVE INGREDIENT:

\*Glyphosate, N-(phosphonomethyl)glycine, in the form of its isopropylamine salt ..... 53.8%  
OTHER INGREDIENTS: ..... 46.2%  
100.0%

\*Contains 648 grams per liter or 5.4 pounds per U.S. gallon of the active ingredient glyphosate, in the form of its isopropylamine salt. Equivalent to 480 grams per liter or 4.0 pounds per U.S. gallon of the acid, glyphosate.

No license granted under any non-U.S. patent(s).

### 2.0 IMPORTANT PHONE NUMBERS

FOR PRODUCT INFORMATION OR ASSISTANCE IN USING THIS PRODUCT,  
CALL TOLL-FREE,  
1-800-332-3111.

IN CASE OF AN EMERGENCY INVOLVING THIS PRODUCT, OR FOR MEDICAL  
ASSISTANCE, CALL COLLECT, DAY OR NIGHT,  
(314) 694-4000.

### 3.0 PRECAUTIONARY STATEMENTS

#### 3.1 Hazards to Humans and Domestic Animals

Keep out of reach of children.

## CAUTION!

Remove contaminated clothing and wash clothing before reuse.  
Wash thoroughly with soap and water after handling.

### 3.2 Environmental Hazards

Do not contaminate water when cleaning equipment or disposing of equipment washwaters. Treatment of aquatic weeds can result in oxygen depletion or loss due to decomposition of dead plants. This oxygen loss can cause fish suffocation.

In case of: SPILL or LEAK, soak up and remove to a landfill.

### 3.3 Physical or Chemical Hazards

Spray solutions of this product should be mixed, stored and applied using only stainless steel, fiberglass, plastic or plastic-lined steel containers.

DO NOT MIX, STORE OR APPLY THIS PRODUCT OR SPRAY SOLUTIONS OF THIS PRODUCT IN GALVANIZED STEEL OR UNLINED STEEL (EXCEPT STAINLESS STEEL) CONTAINERS OR SPRAY TANKS. This product or spray solutions of this product react with such containers and tanks to produce hydrogen gas which may form a highly combustible gas mixture. This gas mixture could flash or explode, causing serious personal injury, if ignited by open flame, spark, welder's torch, lighted cigarette or other ignition source.

#### DIRECTIONS FOR USE

It is a violation of Federal law to use this product in any manner inconsistent with its labeling. This product can only be used in accordance with the Directions for Use on this label or in separately published Monsanto Supplemental Labeling. Supplemental labeling can be found on the [www.cdms.net](http://www.cdms.net) or [www.greenbook.net](http://www.greenbook.net) websites or obtained by contacting your Authorized Monsanto Retailer or Monsanto Company representative. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulations.

### 4.0 STORAGE AND DISPOSAL

Proper pesticide storage and disposal are essential to protect against exposure to people and the environment due to leaks and spills, excess product or waste, and vandalism. Do not allow this product to contaminate water, foodstuffs, feed or seed by storage and disposal.

**PESTICIDE STORAGE:** STORE ABOVE 5°F (-15°C) TO KEEP PRODUCT FROM CRYSTALLIZING. Crystals will settle to the bottom. If allowed to crystallize, place in a warm room 68°F (20°C) for several days to redissolve and roll or shake container or recirculate in mini-bulk containers to mix well before using. Store pesticides away from food, pet food, feed, seed, fertilizers, and veterinary supplies. Keep container closed to prevent spills and contamination.

**PESTICIDE DISPOSAL:** To avoid wastes, use all material in this container, including rinsate, by application according to label directions. If wastes cannot be avoided, offer remaining product to a waste disposal facility or pesticide disposal program. Such programs are often run by state or local governments or by industry. All disposal must be in accordance with applicable Federal, state and local regulations and procedures.

**CONTAINER HANDLING AND DISPOSAL:** See container label for container handling and disposal instructions and refilling limitations.

### 5.0 GENERAL INFORMATION (How This Product Works)

**Product Description:** This product is a postemergence, systemic herbicide with no residual soil activity. It gives broad-spectrum control of many annual weeds, perennial weeds, woody brush and trees. It is formulated as a water-soluble liquid and may be applied through standard equipment after dilution and mixing with water or other carriers according to label instructions.

**Time to Symptoms:** This product moves through the plant from the point of foliage contact to and into the root system. Visible effects are a gradual wilting and yellowing of the plant which advances to complete browning of above-ground growth and deterioration of underground plant parts. Effects are visible on most annual weeds within 2 to 4 days, but on most perennial weeds may not occur for 7 days or more. Extremely cool or cloudy weather following treatment may slow activity of this product and delay development of visual symptoms.

**Stage of Weeds:** Annual weeds are easiest to control when they are small. Best control of most perennial weeds is obtained when treatment is made at late growth stages approaching maturity. Refer to the "WEEDS CONTROLLED" sections for specific weed instructions. Always use the higher product application rate in the labeled range

when weed growth is heavy or dense, or when weeds are growing in an undisturbed (non-cultivated) area. Reduced weed control may result from treating weeds with disease or insect damage, weeds heavily covered with dust, or weeds under poor growing conditions.

**Cultural Considerations:** Reduced control may result when applications are made to annual or perennial weeds that have been mowed, grazed or cut, and have not been allowed to regrow to the specified stage for treatment.

**Rainfastness:** Heavy rainfall soon after application may wash this product off of the foliage and a repeat application may be required for adequate control.

**Mode of Action in Plants:** The active ingredient in this product inhibits production of an enzyme in plants and microorganisms that is essential to formation of specific amino acids.

**No Soil Activity:** Weeds must be emerged at the time of application to be controlled by this product. Weeds germinating from seed after application will not be controlled. Unemerged plants arising from unattached underground rhizomes or rootstocks of perennials will not be affected by the herbicide and will continue to grow.

**Maximum Application Rates:** The maximum application or use rates stated throughout this label are given in units of volume (fluid ounces or quarts) of this product per acre. However, the maximum allowed application rates apply to this product combined with the use of any and all other herbicides containing the active ingredient glyphosate, whether applied separately or as tank mixtures, on a basis of total pounds of glyphosate (acid equivalents) per acre. If more than one glyphosate-containing product is applied to the same site within the same year, you must ensure that the total use of glyphosate (pounds acid equivalents) does not exceed the maximum allowed. The combined total of all treatments must not exceed 8 quarts of this product (8 pounds of glyphosate acid) per acre per year. See the "INGREDIENTS" section of this label for necessary product information.

**ATTENTION**

AVOID CONTACT OF HERBICIDE WITH FOLIAGE, STEMS, EXPOSED NON-WOODY ROOTS OR FRUIT OF CROPS, DESIRABLE PLANTS AND TREES, BECAUSE SEVERE INJURY OR DESTRUCTION MAY RESULT.

AVOID DRIFT. EXTREME CARE MUST BE USED WHEN APPLYING THIS PRODUCT TO PREVENT INJURY TO DESIRABLE PLANTS AND CROPS.

Do not allow the herbicide solution to mist, drip, drift or splash onto desirable vegetation since minute quantities of this product can cause severe damage or destruction to the crop, plants or other areas on which treatment was not intended. The likelihood of injury occurring from the use of this product increases when winds are gusty, as wind velocity increases, when wind direction is constantly changing or when there are other meteorological conditions that favor spray drift. When spraying, avoid combinations of pressure and nozzle type that will result in splatter or fine particles (mist) that are likely to drift. AVOID APPLYING AT EXCESSIVE SPEED OR PRESSURE.

**NOTE:** Use of this product in any manner not consistent with this label may result in injury to persons, animals or crops, or other unintended consequences.

## 5.1 Weed Resistance Management

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Glyphosate, the active ingredient in this product, is a Group 9 herbicide based on the mode of action classification system of the Weed Science Society of America. Any weed population may contain plants naturally resistant to Group 9 herbicides. Weed species resistant to Group 9 herbicides may be effectively managed utilizing another herbicide from a different Group or using other cultural or mechanical practices.

To minimize the occurrence of glyphosate-resistant biotypes observe the following general weed management recommendations:

- Scout your application site before and after herbicide applications.
- Control weeds early when they are relatively small.
- Incorporate other herbicides and cultural or mechanical practices as part of your weed control system where appropriate.
- Use the labeled rate for the most difficult weed in the site. Avoid tank mixtures with other herbicides that reduce this product's efficacy (through antagonism) or with tank mixtures that encourage rates of this product below those specified on this label.
- Control weed escapes and prevent weeds from setting seeds.
- Clean equipment before moving from site to site to minimize spread of weed seed.
- Use new commercial seed as free of weed seed as possible.
- Report any incidence of repeated non-performance of this product on a particular weed to your Monsanto representative, local retailer, or county extension agent.

## 5.2 Management Recommendations for Glyphosate-Resistant Weed Biotypes

**NOTE:** Appropriate testing is critical in order to confirm weed resistance to glyphosate. Contact your Monsanto representative to determine if resistance in any particular weed biotype in your area has been confirmed. Control recommendations for biotypes confirmed as resistant to glyphosate are made available on separately published supplemental

labeling or Fact Sheets for this product and may be obtained from your local retailer or Monsanto representative.

Since the occurrence of new glyphosate-resistant weeds cannot be determined until after product use and scientific confirmation, Monsanto Company is not responsible for any losses that may result from the failure of this product to control glyphosate-resistant weed biotypes.

The following good weed management practices are recommended to reduce the spread of confirmed glyphosate-resistant biotypes:

- If a naturally occurring resistant biotype is present at your site, this product may be tank mixed or applied sequentially with an appropriately labeled herbicide with a different mode of action to achieve control.
- Cultural and mechanical control practices may also be used as appropriate.
- Scout treated sites after herbicide applications and control weed escapes of resistant biotypes before they set seed.
- Thoroughly clean equipment before leaving sites known to contain resistant biotypes.

## 6.0 MIXING

Clean sprayer parts immediately after using this product by thoroughly flushing with water.

**NOTE:** REDUCED RESULTS MAY OCCUR IF WATER CONTAINING SOIL IS USED, SUCH AS VISIBLY MUDDY WATER OR WATER FROM PONDS AND DITCHES THAT IS NOT CLEAR.

### 6.1 Mixing with Water

This product mixes readily with water. Mix spray solutions of this product as follows: Fill the mixing or spray tank with the required amount of water. Add the labeled amount of this product near the end of the filling process and mix well. Use caution to avoid siphoning back into the carrier source. Use approved anti-back-siphoning devices where required by state or local regulations. During mixing and application, foaming of the spray solution may occur. To prevent or minimize foam, avoid the use of mechanical agitators, terminate by-pass and return lines at the bottom of the tank and, if needed, use an approved anti-foam or defoaming agent.

### 6.2 Tank Mixtures

When this product is tank mixed with other products, refer to the tank-mix product labels for approved non-crop sites and application rates. Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used. Use according to the most restrictive precautionary statements for each product in the mixture. Any labeled rate of this product may be used in a tank mix.

When this label lists a tank mixture with a generic active ingredient such as diuron, 2,4-D, or dicamba, the user is responsible for ensuring the mixture product label allows the specific application.

Buyer and all users are responsible for all loss or damage in connection with the use or handling of mixtures of this product with herbicides or other materials that are not expressly listed in this label. Mixing this product with herbicides or other materials not specified on this label may result in reduced performance.

### 6.3 Tank Mixing Procedure

When tank mixing, read and carefully observe label directions, cautionary statements and all information on the labels of all products used. Add the tank-mix product to the tank as directed by the label. Maintain agitation and add the labeled amount of this product.

Maintain good agitation at all times until the contents of the tank are sprayed. If the spray mixture is allowed to settle, thorough agitation is required to resuspend the mixture before spraying is resumed.

Keep by-pass line on or near the bottom of the tank to minimize foaming. Screen size in nozzle or line strainers should be no finer than 50-mesh.

Always predetermine the compatibility of labeled tank mixtures of this product with water carrier by mixing small proportional quantities in advance. Ensure that the specific tank mixture product is registered for application at the desired site.

Refer to the "Tank Mixtures" section for additional precautions.

### 6.4 Mixing Percent Solutions

Prepare the desired volume of spray solution by mixing the amount of this product in water as shown in the following table:

Desired Volume	Amount of AquaMaster herbicide					
	0.5%	0.75%	1%	1.5%	4%	8%
1 gal	2/3 oz	1 oz	1.3 oz	2 oz	5 oz	10 oz
25 gal	1 pt	1.5 pt	1 qt	1.5 qt	4 qt	2 gal
100 gal	2 qt	3 qt	1 gal	1.5 gal	4 gal	8 gal

2 tablespoons = 1 fluid ounce

For use in backpack, knapsack or pump-up sprayers, it is suggested that the amount of this product be mixed with water in a larger container. Fill sprayer with the mixed solution.

## 6.5 Surfactant

This product requires the use of a nonionic surfactant unless otherwise specified. When using this product, unless otherwise specified, mix 2 or more quarts of a nonionic surfactant per 100 gallons of spray solution. Increasing the rate of surfactant may enhance performance. Examples of when to use the higher surfactant rate include, but are not limited to: hard to control woody brush, trees and vines, high water volumes, adverse environmental conditions, tough to control weeds, weeds under stress, surfactants with less than 70 percent active ingredient, tank mixes, etc. These surfactants should not be used in excess of 1 quart per acre when making broadcast applications. Always read and follow the manufacturer's surfactant label for best results. Carefully observe all cautionary statements and other information appearing in the surfactant label.

## 6.6 Colorants or Dyes

Approved colorants or marking dyes may be added to this product. Colorants or dyes used in spray solutions of this product may reduce performance, especially at lower rates or dilution. Use colorants or dyes according to the manufacturer's instructions.

## 6.7 Drift Reduction Additives

Drift reduction additives may be used with all equipment types, except wiper applicators, and sponge bars. When a drift reduction additive is used, read and carefully observe the precautionary statements and all other information appearing on the additive label. The use of drift reduction additives can affect spray coverage which may result in reduced performance.

## 7.0 APPLICATION EQUIPMENT AND TECHNIQUES

Do not apply this product through any type of irrigation system.

APPLY THESE SPRAY SOLUTIONS IN PROPERLY MAINTAINED AND CALIBRATED EQUIPMENT CAPABLE OF DELIVERING DESIRED VOLUMES.

### SPRAY DRIFT MANAGEMENT

AVOID DRIFT. EXTREME CARE MUST BE USED WHEN APPLYING THIS PRODUCT TO PREVENT INJURY TO DESIRABLE PLANTS AND CROPS.

Do not allow the herbicide solution to mist, drip, drift or splash onto desirable vegetation since minute quantities of this product can cause severe damage or destruction to the crop, plants or other areas on which treatment was not intended.

Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment- and weather-related factors determines the potential for spray drift. The applicator and the grower are responsible for considering all these factors when making decisions.

## 7.1 Aerial Equipment

DO NOT APPLY THIS PRODUCT USING AERIAL SPRAY EQUIPMENT EXCEPT UNDER CONDITIONS AS SPECIFIED WITHIN THIS LABEL.

FOR AERIAL APPLICATION IN CALIFORNIA, REFER TO THE FEDERAL SUPPLEMENTAL LABELING FOR AERIAL APPLICATIONS IN THAT STATE OR COUNTY FOR SPECIFIC INSTRUCTIONS, RESTRICTIONS AND REQUIREMENTS.

This product, when tank mixed with dicamba, may not be applied by air in California. Only 2,4-D amine formulations may be applied by air in California.

TO PREVENT INJURY TO ADJACENT DESIRABLE VEGETATION, APPROPRIATE BUFFER ZONES MUST BE MAINTAINED.

Avoid direct application to any body of water.

Use the labeled rates of this herbicide in 3 to 25 gallons of water per acre.

Ensure uniform application. To avoid streaked, uneven or overlapped application, use appropriate marking devices.

### AERIAL SPRAY DRIFT MANAGEMENT

The following drift management requirements must be followed to avoid off-target drift movement from aerial applications to agricultural field crops. These requirements do not apply to public health uses.

1. The distance of the outermost nozzles on the boom must not exceed 3/4 the length of the wingspan or rotor.
2. Nozzles must always point backward parallel with the air stream and never be pointed downwards more than 45 degrees. Where states have more stringent regulations, they should be observed.

### Importance of Droplet Size

The most effective way to reduce drift potential is to apply large droplets. The best drift management strategy is to apply the largest droplets that provide sufficient coverage and control. Applying larger droplets reduces drift potential, but will not prevent drift if applications are made improperly, or under unfavorable environmental conditions (see

the "Wind", "Temperature and Humidity", and "Temperature Inversions" sections of this label).

### Controlling Droplet Size

- **Volume:** Use high flow rate nozzles to apply the highest practical spray volume. Nozzles with the higher rated flows produce larger droplets.
- **Pressure:** Use the lower spray pressures recommended for the nozzle. Higher pressure reduces droplet size and does not improve canopy penetration. When higher flow rates are needed, use higher flow rate nozzles instead of increasing pressure.
- **Number of nozzles:** Use the minimum number of nozzles that provide uniform coverage.
- **Nozzle orientation:** Orienting nozzles so that the spray is released backwards, parallel to the air stream, will produce larger droplets than other orientations. Significant deflection from the horizontal will reduce droplet size and increase drift potential.
- **Nozzle type:** Use a nozzle type that is designed for the intended application. With most nozzle types, narrower spray angles produce larger droplets. Consider using low-drift nozzles. Solid stream nozzles oriented straight back produce larger droplets than other nozzle types.
- **Boom length:** For some use patterns, reducing the effective boom length to less than 3/4 of the wingspan or rotor length may further reduce drift without reducing swath width.
- **Application height:** Applications should not be made at a height greater than 10 feet above the top of the largest plants unless a greater height is required for aircraft safety. Making applications at the lowest height that is safe reduces the exposure of the droplets to evaporation and wind.

### Swath Adjustment

When applications are made with a crosswind, the swath will be displaced downwind. Therefore, on the up and downwind edges of the field, the applicator must compensate for this displacement by adjusting the path of the aircraft upwind. Swath adjustment distance should increase, with increasing drift potential (higher wind, smaller droplets, etc.).

### Wind

Drift potential is lowest between wind speeds of 2 to 10 miles per hour. However, many factors, including droplet size and equipment type determine drift potential at any given speed. Application should be avoided below 2 miles per hour due to variable wind direction and high inversion potential. **NOTE:** Local terrain can influence wind patterns. Every applicator should be familiar with local wind patterns and how they affect drift.

### Temperature and Humidity

Set up equipment to produce larger droplets when making applications in low relative humidity to compensate for evaporation. Droplet evaporation is most severe when conditions are both hot and dry.

### Temperature Inversions

Applications should not occur during a temperature inversion because drift potential is high. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain in a concentrated cloud. This cloud can move in unpredictable directions due to the light variable winds common during inversions. Temperature inversions are characterized by increasing temperatures with altitude and are common on nights with limited cloud cover and light to no wind. They begin to form as the sun sets and often continue into the morning. Their presence can be indicated by ground fog; however, if fog is not present, inversions can also be identified by the movement of smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally in a concentrated cloud (under low wind conditions) indicates an inversion, while smoke that moves upward and rapidly dissipates indicates good vertical air mixing.

### Sensitive Areas

This product should only be applied when the potential for drift to adjacent sensitive areas (e.g., residential areas, bodies of water, known habitat for threatened or endangered species, non-target crops) is minimal (e.g., when wind is blowing away from the sensitive areas).

### Aircraft Maintenance

PROLONGED EXPOSURE OF THIS PRODUCT TO UNCOATED STEEL SURFACES MAY RESULT IN CORROSION AND POSSIBLE FAILURE OF THE PART. The maintenance of an organic coating (paint) which meets aerospace specification MIL-C-38413 may prevent corrosion. To prevent corrosion of exposed parts, thoroughly wash aircraft after each day of spraying to remove residues of this product accumulated during spraying or from spills. Landing gear is most susceptible.

## 7.2 Ground Broadcast Equipment

For broadcast ground applications, unless otherwise specified in this label or in separate supplemental labeling or Fact Sheets published by Monsanto, use this product at the rate of 1.5 to 3 pints per acre for annual weeds, 3 to 7.5 pints per acre for perennial weeds and 3 to 7.5 pints per acre for woody brush and trees. When used according to label directions this product will give control or partial control of herbaceous weeds, woody brush and trees listed in the "WEEDS CONTROLLED" section of this label.

Use the labeled rates of this product in 3 to 40 gallons of water per acre as a broadcast spray unless otherwise specified. As density of weeds increases, spray volume should be increased within the labeled range to ensure complete coverage. Carefully select proper nozzles to avoid spraying a fine mist. For best results with ground application equipment, use flat-fan nozzles. Check spray pattern for even distribution of spray droplets.

## 7.3 Hand-Held Equipment

Apply to foliage of vegetation to be controlled. For applications made on a spray-to-wet basis, spray coverage should be uniform and complete. Do not spray to the point of runoff. Use coarse sprays only.

For control of weeds listed in the "Annual Weeds" section of "WEEDS CONTROLLED", apply a 0.5-percent solution of this product to weeds less than 6 inches in height or runner length. For annual weeds over 6 inches tall, or unless otherwise specified, use a 1-percent solution. Apply prior to seedhead formation in grass or bud formation in broadleaf weeds.

For best results, use a 1.5-percent solution on harder-to-control perennials, woody vines, brush and trees. Make applications to perennials after seedhead emergence in grasses or bud formation in broadleaf weeds, woody brush and trees for best results.

For low-volume directed spray applications, use a 4- to 8-percent solution of this product for control or partial control of annual weeds, perennial weeds, or woody brush and trees. Spray coverage should be uniform with at least 50 to 75 percent of the foliage contacted. Coverage of the top one half of the plant is important for best results. If a straight stream nozzle is used, start the application at the top of the targeted vegetation and spray from top to bottom in a lateral zigzag motion. For flat-fan and cone nozzles and with hand-directed mist blowers, mist the application over the foliage of the targeted vegetation. To ensure adequate spray coverage, spray both sides of large or tall woody brush and trees, when foliage is thick and dense, or where there are multiple sprouts. For best results, apply to actively growing woody brush and trees after full leaf expansion and before fall color and leaf drop.

Unless otherwise specified, use the rates listed in the following "Application Rates" table for various methods of foliar application using high-volume, backpack, knapsack and similar types of hand-held equipment. When used according to label directions this product will give control or partial control of herbaceous weeds, woody brush and trees listed in the "WEEDS CONTROLLED" section of this label.

### Application Rates

APPLICATION	AQUAMASTER HERBICIDE	SPRAY VOLUME GALLONS/ACRE
<b>SPRAY-TO-WET</b>		
Handgun or Backpack	0.5 to 1.5% by volume	spray-to-wet*
<b>LOW-VOLUME DIRECTED SPRAY</b>		
Backpack	4 to 8% by volume	15 to 25**
Modified High-Volume	1.5 to 3% by volume	40 to 60**

\*For applications made on a spray-to-wet basis, spray coverage should be uniform and complete. Do not spray to the point of runoff.

\*\*Low-volume directed applications with backpacks work best when treating weeds and brush less than 10 feet tall. For taller weeds and brush, high-volume handguns can be modified by reducing nozzle size and spray pressure to produce a low-volume directed spray.

## 7.4 Selective Equipment

This product may be applied through shielded applicators, hooded sprayers, wiper applicators or sponge bars, after dilution and thorough mixing with water, to listed weeds growing in any aquatic or non-crop site specified on this label.

**AVOID CONTACT OF HERBICIDE WITH DESIRABLE VEGETATION, AS SERIOUS INJURY OR DEATH IS LIKELY TO OCCUR:**

Applicators used above desired vegetation should be adjusted so that the lowest spray stream or wiper contact point is at least 2 inches above the desirable vegetation. Droplets, mist, foam or splatter of the herbicide solution settling on desirable vegetation is likely to result in discoloration, stunting or destruction.

Better results may be obtained when more of the weed is exposed to the herbicide solution. Weeds not contacted by the herbicide solution will not be affected. This may occur in dense clumps, severe infestations or when the height of the weeds varies so that not all weeds are contacted. In these instances, repeat treatment may be necessary.

### Shielded and Hooded Applicators

A shielded or hooded applicator directs the herbicide solution onto weeds, while shielding desirable vegetation from the herbicide. Use nozzles that provide uniform coverage within the treated area. Keep shields on these sprayers adjusted to protect desirable vegetation. **EXTREME CARE MUST BE EXERCISED TO AVOID CONTACT OF HERBICIDE WITH DESIRABLE VEGETATION.**

### Wiper Applicators and Sponge Bars

Wiper applicators are devices that physically wipe appropriate amounts of this product directly onto the weed.

Equipment must be designed, maintained and operated to prevent the herbicide solution from contacting desirable vegetation. Operate this equipment at ground speeds no greater than 5 miles per hour. Performance may be improved by reducing speed in areas of heavy weed infestations to ensure adequate wiper saturation. Better results may be obtained if 2 applications are made in opposite directions.

Avoid leakage or dripping onto desirable vegetation. Adjust height of applicator to ensure adequate contact with weeds. Keep wiping surfaces clean. Be aware that, on sloping ground, the herbicide solution may migrate, causing dripping on the lower end and drying of the wicks on the upper end of a wiper applicator.

Do not use wiper equipment when weeds are wet.

Mix only the amount of solution to be used during a 1-day period, as reduced activity may result from the use of leftover solutions. Clean wiper parts immediately after using this product by thoroughly flushing with water.

Nonionic surfactant at a rate of 10 percent by volume of total herbicide solution is recommended with all wiper applications.

**For Rope or Sponge Wick Applicators**—Solutions ranging from 33 to 75 percent of this product in water may be used.

**For Panel Applicators**—Solutions ranging from 33 to 100 percent of this product in water may be used in panel wiper applicators.

## 8.0 SITE AND USE INSTRUCTIONS

Unless otherwise specified, applications may be made to control any weeds listed in the "Annual Weeds", "Perennial Weeds" and "Woody Brush and Trees" rate tables. Refer also to the "Selective Equipment" section.

### 8.1 Aquatic Sites

This product may be applied to emerged weeds in all bodies of fresh and brackish water which may be flowing, nonflowing or transient. This includes lakes, rivers, streams, ponds, estuaries, rice levees, seeps, irrigation and drainage ditches, canals, reservoirs, wastewater treatment facilities, wildlife habitat restoration and management areas.

This product may also be used to control the labeled weeds, woody brush and trees growing in other terrestrial non-crop sites listed on this label or in aquatic sites within these areas.

If aquatic sites are present in a non-crop area and are part of the intended treatment, read and observe the following directions:

**This product does not control plants which are completely submerged or have a majority of their foliage under water.**

There is no restriction on the use of treated water for irrigation, recreation or domestic purposes.

Consult local state fish and game agency and water control authorities before applying this product to public water. Permits may be required to treat such water.

**NOTE:** Do not apply this product **directly to water** within 0.5 mile upstream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within 0.5 mile of an active potable water intake in a standing body of water such as lake, pond or reservoir. To make aquatic applications around and within 0.5 mile of active potable water intakes, the water intake must be turned off for a minimum period of 48 hours after the application. The water intake may be turned on prior to 48 hours if the glyphosate level in the intake water is below 0.7 parts per million as determined by laboratory analysis. These aquatic applications may be made **ONLY** in those cases where there are alternative water sources or holding ponds which would permit the turning off of an active potable water intake for a minimum period of 48 hours after the applications. This restriction does **NOT** apply to intermittent inadvertent overspray of water in terrestrial use sites.

For treatments after drawdown of water or in dry ditches, allow 7 or more days after treatment before reintroduction of water to achieve maximum weed control. Apply this product within 1 day after drawdown to ensure application to actively growing weeds.

Floating mats of vegetation may require retreatment. Avoid wash-off of sprayed foliage by spray boat or recreational boat backwash or by rainfall within 6 hours of application. Do not retreat within 24 hours following the initial treatment.

Applications made to moving bodies of water must be made while traveling upstream to prevent concentration of this herbicide in water. When making any bankside applications, do not overlap more than 1 foot into open water. Do not spray in bodies of water where weeds do not exist. The maximum application rate of 7.5 pints per acre must not be exceeded in any single broadcast application that is being made over water except as follows, where any labeled rate may be applied:

- Stream crossings in utility rights-of-way.
- Where applications will result in less than 20 percent of the total water area being treated.

When emerged infestations require treatment of the total surface area of impounded water, treating the area in strips may avoid oxygen depletion due to decaying vegetation. Oxygen depletion may result in fish kill.

### Tank Mixtures

Tank mixtures of this product plus 2,4-D amine may be used to increase the spectrum of vegetation controlled in aquatic sites. Use 1.5 to 2 pints of this product plus 1 to 2 quarts of 2,4-D amine (4 pounds active ingredient per gallon, labeled for aquatic sites) for control of annual weeds. Use 3 to 7.5 pints of this product plus 2 to 4 quarts of 2,4-D amine (4 pounds active ingredient per gallon, labeled for aquatic sites) for control or partial control of perennial weeds, woody brush and trees.

When tank mixing, read and carefully observe the label claims, cautionary statements and all information on the labels of all products used. Use according to the most restrictive precautionary statements for each product in the mixture. Mix in the following sequence: Fill sprayer tank one-half full with water, add AquaMaster herbicide, then 2,4-D amine and finally surfactant. Fill sprayer tank to final volume of water.

**NOTE:** DO NOT MIX AQUAMASTER HERBICIDE AND 2,4-D AMINE CONCENTRATES WITHOUT WATER CARRIER. DO NOT MIX AQUAMASTER HERBICIDE AND 2,4-D AMINE IN BYPASS INJECTOR-TYPE SPRAY EQUIPMENT.

#### For Control of Cordgrass (*Spartina spp.*)

The presence of debris and silt on the surface of cordgrass plants will reduce product performance. It may be necessary to wash targeted plants prior to application to improve herbicide uptake. Where cordgrass has been cut or mowed prior to application, allow significant regrowth before application to ensure adequate interception and uptake of the herbicide solution. Rainfall within 2 hours or immersion within 4 hours after application may reduce effectiveness.

Prior to application, survey the areas to be treated to determine if shellfish beds exist within the intended treatment area. Wait either until shellfish have been harvested before application is made or do not harvest shellfish for 14 days following treatment.

Add 1 to 2 quarts or more of nonionic surfactant or other adjuvant approved for use on aquatic sites and compatible with this product per 100 gallons of spray solution for broadcast applications (ground or air) and when using optical sensing application equipment.

Do not apply this product through any type of irrigation system.

**APPLICATION:** Under ideal application conditions, that is, where silt and debris are not present on plant surfaces, good spray coverage is achievable, target plants are actively growing and labeled rates and application volumes are used, allow at least 4 hours drying time before plants are covered by tidewater. Where one or more of these conditions are not met, schedule applications to allow at least 5 hours drying time before plants are covered by tidewater. Do not apply when wind speed at the application site exceed 10 miles per hour.

**Broadcast Application (Ground):** Apply 2 to 8 quarts of this herbicide in 5 to 100 gallons of spray solution per acre. For best results, complete coverage of cordgrass clumps is required.

**Broadcast Application (Ground/Optical Sensing Application Equipment):** Apply 2 to 8 quarts of this product in 5 to 100 gallons of spray solution per acre using equipment designed and calibrated to deliver spray solution only when cordgrass plants are present and detected by optical sensors. For best results, complete coverage of cordgrass clumps is required.

**Hand-Held Backpack or High-Volume Equipment:** Apply a 5 to 8 percent solution of this product. Ensure that complete coverage of cordgrass clumps is achieved. Do not spray to the point of runoff.

**Broadcast Application (Air):** Apply 2 to 8 quarts of this product in 5 to 10 gallons of spray solution per acre. Maintain at least a 50-foot buffer between commercial shellfish beds and treated areas. The potential for spray drift is dependent upon weather- and equipment-related factors. The applicator must be familiar with local wind patterns and monitor and record temperature and wind speed prior to and periodically during application. Schedule application in order to allow at least 5 hours before treated plants are covered by tidewater.

#### For Control of Giant Salvinia

For control of Giant Salvinia, this product may be applied as a 2.0% v/v spray-to-wet solution with 0.5 to 2.0% v/v of a nonionic surfactant containing at least 70 percent active ingredient. Ensure thorough coverage when using spray-to-wet treatments using hand-held equipment.

For broadcast applications, apply 3 to 3.75 quarts of this product with an aquatic approved surfactant system containing 0.1% v/v nonionic organosilicone and 0.25% v/v nonionic spreader sticker surfactant in 3 to 40 gallons per acre as a broadcast treatment.

Allow at least 3 days after application before disturbing treated vegetation. This product does not control plants which are completely submerged or have a majority of their foliage under water.

## 8.2 Hollow Stem Injection

This product may be applied through hand-held injection devices that deliver labeled amounts of this product into targeted hollow stem plants growing in any aquatic or non-crop site specified on this label. For control of the following hollow stem plants, follow the use instructions below:

#### Castorbean (*Ricinus communis*)

Inject 4 mL/plant of this product into the lower portion of the main stem.

#### Hemlock, Poison (*Conium maculatum*)

Inject one leaf cane per plant 10 to 12 inches above root crown with 5 mL of a 5% v/v solution of this product.

#### Hogweed, Giant (*Heracleum mantegazzianum*)

Inject one leaf cane per plant 12 inches above root crown with 5 mL of a 5% v/v solution of this product.

#### Horsetail, Field (*Equisetum arvense*)

Inject one segment above the root crown with 0.5 mL/stem of this product. Use a small syringe that calibrates to this rate.

#### Iris, Yellow Flag (*Iris pseudocorus*)

Cut flower stems with clippers 8 to 9 inches above the root crown. Use a cavity needle that is pushed into the stem center and then slowly removed as 0.5 mL/stem of this product is injected into the stem.

#### Knotweed, Bohemian (*Polygonum bohemicum*),

#### Knotweed, Giant (*Polygonum sachalinense*), and

#### Knotweed, Japanese (*Polygonum cuspidatum*)

Inject 5 mL/stem of this product between second and third internode.

#### Reed, Giant (*Arundo donax*)

Inject 6 mL/stem of this product between second and third internode.

#### Thistle, Canada (*Cirsium arvense*)

Cut 8 to 9 of the tallest plants at bud stage in a clump with clippers. Use a cavity needle that is pushed into the stem center and then slowly removed as 0.5 mL/stem of this product is injected into the stem.

**NOTE:** Based on the maximum annual use rate of glyphosate for these non-crop sites, the combined total for all treatments must not exceed 8 quarts of this product per acre. At 5 mL per stem, 8 quarts should treat approximately 1500 stems.

## 8.3 Cut Stump

Cut stump treatments may be made on any site listed on this label. This product will control many types of woody brush and tree species. Apply this product using suitable equipment to ensure coverage of the entire cambium. Cut trees or resprouts close to the soil surface. Apply a 50- to 100-percent solution of this product to the freshly-cut surface immediately after cutting. Delays in application may result in reduced performance. For best results, applications should be made during periods of active growth and full leaf expansion.

For control of *Ailanthus altissima* (Tree-of-heaven) make a cut stump treatment according to the directions in this section using a spray mixture of 50 percent AquaMaster herbicide and 10 percent Arsenal.

**DO NOT MAKE CUT STUMP APPLICATIONS WHEN THE ROOTS OF DESIRABLE WOODY BRUSH OR TREES MAY BE GRAFTED TO THE ROOTS OF THE CUT STUMP.** Some sprouts, stems, or trees may share the same root system. Adjacent trees having a similar age, height and spacing may signal shared roots. Whether grafted or shared, injury is likely to occur to non-treated stems/trees when one or more trees sharing common roots are treated.

## 8.4 General Non-crop Areas and Industrial Sites

Use in areas such as airports, apartment complexes, commercial sites, ditch banks, driveways, dry ditches, dry canals, fencerows, forestry sites, golf courses, greenhouses, industrial sites, lumber yards, manufacturing sites, municipal sites, natural areas, office complexes, ornamentals, parks, parking areas, pastures, petroleum tank farms and pumping installations, railroads, rangeland, recreational areas, residential areas, rights-of-way, roadsides, schools, sod or turf seed farms, sports complexes, storage areas, substations, utility sites, warehouse areas, and wildlife management areas.

#### General Weed Control, Trim-and-Edge and Bare Ground

This product may be used in general non-crop areas. It may be applied with any application equipment described in this label. This product may be used to trim-and-edge around objects in non-crop sites, for spot treatment of unwanted vegetation and to eliminate unwanted weeds growing in established shrub beds or ornamental plantings. This product may be used prior to planting an area to ornamentals, flowers, turfgrass (sod or seed), or prior to laying asphalt or beginning construction projects.

Repeated applications of this product may be used, as weeds emerge, to maintain bare ground.

**TANK MIXTURES:** This product may be tank mixed with the following products. Refer to these product labels for approved non-crop sites and application rates. Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used. Use according to the most restrictive precautionary statements for each product in the mixture.

Arsenal	Outrider®
Barricade 65WG	Pendulum 3.3 EC
Certainty®	Pendulum WDG
diuron*	Plateau
Endurance	Princep DF
Escort XP	Princep Liquid
Garlon 3A	Ronstar 50 WP
Garlon 4	Sahara
Hyvar X	simazine*
Karmex	Surflan
Krovar I DF	Telar
Oust XP	2,4-D*

\*User is responsible for ensuring that tank mixtures with products containing this generic active ingredient may be made provided the specific product is registered for this use.

This product plus dicamba tank mixtures may not be applied by air in California.

## Brush Control Tank Mixtures

**TANK MIXTURES:** Tank mixtures of this product may be used to increase the spectrum of control for herbaceous weeds, woody brush and trees. When tank mixing, read and carefully observe the label claims, cautionary statements and all information on the labels of all products used. Use according to the most restrictive precautionary statements for each product in the mixture. Any labeled rate of this product may be used in a tank mix.

For control of herbaceous weeds, use the lower tank mixture rates. For control of dense stands or tough-to-control woody brush and trees, use the higher rates.

**NOTE:** For side trimming treatments, this product may be used alone or in tank mixture with Garlon 4.

### PRODUCT

Arsenal  
Escort XP  
Garlon 3A\*  
Garlon 4

\*Ensure that Garlon 3A is thoroughly mixed with water according to label directions before adding this product. Have spray mixture agitating at the time this product is added to avoid spray compatibility problems.

## 8.5 Habitat Management

### Habitat Restoration and Management

This product may be used to control exotic and other undesirable vegetation in habitat management and natural areas, including riparian and estuarine areas, rangeland and wildlife refuges. Applications can be made to allow recovery of native plant species, prior to planting desirable native species, and for similar broad-spectrum vegetation control requirements. Spot treatments can be made to selectively remove unwanted plants for habitat management and enhancement.

### Wildlife Food Plots

This product may be used as a site preparation treatment prior to planting wildlife food plots. Any wildlife food species may be planted after applying this product, or native species may be allowed to repopulate the area. If tillage is needed to prepare a seedbed, wait 7 days after application before tillage to allow translocation into underground plant parts.

## 8.6 Injection and Frill (Woody Brush and Trees)

This product may be used to control woody brush and trees by injection or frill applications. Apply this product using suitable equipment that must penetrate into the living tissue. Apply 1 mL of this product per each 2 to 3 inches of trunk diameter at breast height (DBH). This is best achieved by applying a 50- to 100-percent concentration of this product either to a continuous frill around the tree or as cuts evenly spaced around the tree below all branches. As tree diameter increases in size, better results are achieved by applying diluted material to a continuous frill or more closely spaced cuttings. Avoid application techniques that allow runoff to occur from frilled or cut areas in species that exude sap freely. In species such as this, make the frill or cuts at an oblique angle to produce a cupping effect and use a 100-percent concentration of this product. For best results, application should be made during periods of active growth and after full leaf expansion.

## 8.7 Roadsides

All of the instructions in the "General Non-Crop Areas and Industrial Sites" section apply to roadsides.

### Shoulder Treatments

This product may be used on road shoulders. It may be applied with boom sprayers, shielded boom sprayers, high-volume off-center nozzles, hand-held equipment, and similar equipment.

### Guardrails and Other Obstacles to Mowing

This product may be used to control weeds growing under guardrails and around signposts and other objects along the roadside.

### Spot Treatment

This product may be used as a spot treatment to control unwanted vegetation growing along roadsides.

**TANK MIXTURES:** This product may be tank mixed with the following products for shoulder, guardrail, spot and bare ground treatments, provided that the specific tank mixture product is registered for use on such sites. Refer to these product labels for approved non-crop sites and application rates. Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used. Use according to the most restrictive precautionary statements for each product in the mixture.

atrazine*	Landmark MP	Sahara DG
Crossbow L	Landmark XP	simazine*
dicamba*	Oust XP	Surflan AS
diuron*	Outrider	Surflan WDG
Endurance	pendimethalin*	Telar DF
Escort XP	Plateau	Velpar DF
Gallery 75 DF	Plateau DG	Velpar L
Krovar I DF	Poast	2,4-D*
Landmark II MP	Ronstar 50 WSP	

\*User is responsible for ensuring that tank mixtures with products containing this generic active ingredient may be made provided the specific product is registered for this use.

See the "MIXING" section of this label for general instructions for tank mixing.

### Release of Bermudagrass or Bahiagrass

#### Dormant Applications

This product may be used to control or partially control many winter annual weeds and tall fescue for effective release of dormant bermudagrass or bahiagrass. Treat only when turf is dormant and prior to spring greenup. This product may also be tank mixed with Outrider herbicide or Oust XP for residual control. Tank mixtures of this product with Oust XP may delay greenup.

For best results on winter annuals, treat when plants are in an early growth stage (below 6 inches in height) after most have germinated. For best results on tall fescue, treat when fescue is at or beyond the 4- to 6-leaf stage.

Apply 6 to 48 ounces of this product in a tank mixture with 0.75 to 1.33 ounces Outrider herbicide per acre. Read and follow all label directions for Outrider herbicide.

**TANK MIXTURES:** Apply 6 to 48 fluid ounces of this product per acre alone or in a tank mixture with 0.25 to 1 ounce per acre of Oust XP. Apply the labeled rates in 10 to 40 gallons of water per acre. Use only in areas where bermudagrass or bahiagrass are desirable ground covers and where some temporary injury or discoloration can be tolerated. To avoid delays in greenup and minimize injury, add no more than 1 ounce of Oust XP per acre on bermudagrass and no more than 0.5 ounce of Oust XP per acre on bahiagrass and avoid treatments when these grasses are in a semi-dormant condition.

#### Actively Growing Bermudagrass

This product may be used to control or partially control many annual and perennial weeds for effective release of actively growing bermudagrass. Apply 12 to 36 fluid ounces of this product in 10 to 40 gallons of spray solution per acre. Use the lower rate when treating annual weeds below 6 inches in height (or runner length). Use the higher rate as weeds increase in size or as they approach flower or seedhead formation. These rates will also provide partial control of the following perennial species:

Bahiagrass	Johnsongrass
Bluestem, silver	Trumpetcreeper
Fescue, tall	Vaseygrass

This product may be tank mixed with Outrider herbicide for control or partial control of Johnsongrass and other weeds listed in the Outrider herbicide label. Use 6 to 24 ounces of this product with 0.75 to 1.33 ounces of Outrider herbicide. Use the higher rates of both products for control of perennial weeds or annual weeds greater than 6 inches in height.

**TANK MIXTURES:** This product may be tank mixed with Oust XP. If tank mixed, use no more than 12 to 24 fluid ounces of this product with 1 to 2 ounces of Oust XP per acre. Use the lower rates of each product to control annual weeds less than 6 inches in height (or runner length) that are listed in this label and the Oust XP label. Use the higher rates as annual weeds increase in size and approach the flower or seedhead stages. These rates will also provide partial control of the following perennial weeds:

Bahiagrass	Fescue, tall
Bluestem, silver	Johnsongrass
Broomsedge	Poorjoe
Dallisgrass	Trumpetcreeper
Dock, curly	Vaseygrass
Dogfennel	Vervain, blue

Use only on well-established bermudagrass. Bermudagrass injury may result from the treatment, but regrowth will occur under moist conditions. Repeat applications of the tank mix in the same season are not recommended, since severe injury may occur.

#### Actively Growing Bahiagrass

For suppression of vegetative growth and seedhead inhibition of bahiagrass for approximately 45 days, apply 4 fluid ounces of this product in 10 to 40 gallons of water per acre. Apply 1 to 2 weeks after full greenup or after mowing to a uniform height of 3 to 4 inches. This application must be made prior to seedhead emergence.

For suppression up to 120 days, apply 3 fluid ounces of this product per acre, followed by an application of 2 to 3 fluid ounces per acre about 45 days later. Make no more than 2 applications per year.

This product may be used for control or partial control of Johnsongrass and other weeds listed on the Outrider herbicide label in actively growing bahiagrass. Apply 1.5 to 3.5 fluid ounces of this product with 0.75 to 1.33 ounces of Outrider herbicide per acre. Use the higher rates for control of perennial weeds or annual weeds greater than 6 inches in height. Use only on well established bahiagrass.

**TANK MIXTURES:** A tank mixture of this product plus Oust XP may be used. Apply 4 fluid ounces of this product plus 0.25 ounce of Oust XP per acre 1 to 2 weeks following an initial spring mowing. Make only one application per year.

## 9.0 WEEDS CONTROLLED

Always use the higher rate of this product per acre within the labeled range when weed growth is heavy or dense or weeds are growing in an undisturbed (non-cultivated) area.

Reduced results may occur when treating weeds heavily covered with dust. For weeds that have been mowed, grazed or cut, allow regrowth to occur prior to treatment.

Refer to the following label sections for application rates for the control of annual and perennial weeds and woody brush and trees. For difficult to control perennial weeds and woody brush and trees, where plants are growing under stressed conditions, or where infestations are dense, this product may be used at 4.5 to 8 quarts per acre for enhanced results.

### 9.1 Annual Weeds

Apply to actively growing annual grasses and broadleaf weeds.

Allow at least 3 days after application before disturbing treated vegetation. After this period the weeds may be mowed, tilled or burned. See the "GENERAL INFORMATION" and "MIXING" and "APPLICATION EQUIPMENT AND TECHNIQUES" sections for labeled uses and specific application instructions.

Use 1.5 pints per acre if weeds are less than 6 inches in height or runner length and 1 to 4 quarts per acre if weeds are over 6 inches in height or runner length or when weeds are growing under stressed conditions.

For spray-to-wet applications, apply a 0.5-percent solution of this product to weeds less than 6 inches in height or runner length. Apply prior to seedhead formation in grass or bud formation in broadleaf weeds. For annual weeds over 6 inches tall, or for smaller weeds growing under stressed conditions, use a 0.75- to 1.5-percent solution. Use the higher rate for tough-to-control species or for weeds over 24 inches tall.

#### WEED SPECIES

Anoda, spurred	Lamb's-quarters*
Balsamapple**	Lettuce, prickly*
Barley*	Mannagrass, eastern*
Barley, little*	Mayweed
Barnyardgrass*	Medusahead*
Bassia, fivehook	Morningglory ( <i>Ipomoea spp</i> )
Bittercress*	Mustard, blue*
Bluegrass, annual*	Mustard, tansy*
Bluegrass, bulbous*	Mustard, tumble*
Brome, downy*	Mustard, wild*
Brome, Japanese*	Nightshade, black*
Broomsedge	Oats
Buttercup*	Panicum, browntop*
Castorbean	Panicum, fall*
Cheatgrass*	Panicum, Texas*
Cheeseweed	Pennycress, field*
( <i>Malva parviflora</i> )	Pepperweed, Virginia*
Chervil*	Pigweed*
Chickweed*	Puncturevine
Cocklebur*	Purslane, common
Copperleaf, hophornbeam	Pusley, Florida
Copperleaf, Virginia	Ragweed, common*
Coreopsis, plains/tickseed*	Ragweed, giant
Corn*	Rice, red
Crabgrass*	Rocket, London*
Cupgrass, woolly*	Rocket, yellow
Dwarfdandelion*	Rye*
Eclipta*	Ryegrass*
Falsedandelion*	Sandbur, field*
Falseflax, smallseed*	Sesbania, hemp
Fiddleneck	Shattercane*
Filaree	Shepherd's-purse*
Fleabane, annual*	Sicklepod
Fleabane, hairy	Signalgrass, broadleaf*
( <i>Conyza bonariensis</i> )*	Smartweed, ladysthumb*
Fleabane, rough*	Smartweed, Pennsylvania*
Foxtail*	Sorghum, grain (milo)*
Foxtail, Carolina*	Sowthistle, annual
Geranium, Carolina	Spanishneedles***
Goatgrass, jointed*	Speedwell, corn*
Goosegrass	Speedwell, purslane*
Groundsel, common*	Sprangletop*
Henbit	Spurge, annual
Horseweed/Marestail	Spurge, prostrate*
( <i>Conyza canadensis</i> )	Spurge, spotted*
Itchgrass*	Spurry, umbrella*
Johnsongrass, seedling	Starthistle, yellow
Junglerice	Stinkgrass*
Knotweed	Sunflower*
Kochia	Teaweed/prickly sida

Thistle, Russian	Wild oats*
Velvetleaf	Witchgrass
Wheat*	

\*When using field broadcast equipment (aerial applications or boom sprayers using flat-fan nozzles) these species will be controlled or partially controlled using 12 fluid ounces of this product per acre. Applications must be made using 3 to 10 gallons of carrier volume per acre. Use nozzles that ensure thorough coverage of foliage and treat when weeds are in an early growth stage.

\*\*Apply with hand-held equipment only.

\*\*\*Apply 3 pints of this product per acre.

### 9.2 Perennial Weeds

Best results are obtained when perennial weeds are treated after they reach the reproductive stage of growth (seedhead initiation in grasses and bud formation in broadleaves). For non-flowering plants, best results are obtained when the plants reach a mature stage of growth. In many situations, treatments are required prior to these growth stages. Under these conditions, use the higher application rate within the labeled range.

Ensure thorough coverage when using spray-to-wet treatments using hand-held equipment. When using hand-held equipment for low-volume directed spot treatments, apply a 4- to 8-percent solution of this product.

Allow 7 or more days after application before tillage. If weeds have been mowed or tilled, do not treat until regrowth has reached the specified stages. Fall treatments must be applied before a killing frost.

Repeat treatments may be necessary to control weeds regenerating from underground parts or seed.

WEED SPECIES	RATE (QT/A)	HAND-HELD % SOLUTION
Alfalfa*	0.7	1.5
Alligatorweed*	3.0	1.3
Anise (fennel)	1.5 - 3.0	1.0 - 1.5
Bahiagrass	2.3 - 3.75	1.5
Beachgrass, European		
( <i>Ammophila arenaria</i> )	-	3.5
Bentgrass*	1.0	1.5
Bermudagrass	4.0	1.5
Bermudagrass, water		
(knotgrass)	1.0	1.5
Bindweed, field	3.0 - 3.75	1.5
Bluegrass, Kentucky	1.5 - 2.3	0.75
Blueweed, Texas	3.0 - 3.75	1.5
Brackenfern	2.3 - 3.0	0.75 - 1.0
Bromegrass, smooth	1.5 - 2.3	0.75
Bursage, woolly-leaf	-	1.5
Canarygrass, reed	1.5 - 2.3	0.75
Cattail	2.3 - 3.75	0.75
Clover, red, white	2.3 - 3.75	1.5
Cogongrass	2.3 - 3.75	1.5
Cordgrass	2.3 - 3.75	1.0 - 2.0
Cutgrass, giant	3.0	1.0
Dallisgrass	2.3 - 3.75	1.5
Dandelion	2.3 - 3.75	1.5
Dock, curly	2.3 - 3.75	1.5
Dogbane, hemp	3.0	1.5
Fescue (except tall)	2.3 - 3.75	1.5
Fescue, tall	2.3	1.0
Guineagrass	2.3	0.75
Hemlock, poison	1.5 - 3.0	0.75 - 1.5
Horsenettle	2.3 - 3.75	1.5
Horseradish	3.0	1.5
Iceplant	1.5	1.5
Ivy; German, cape	1.5 - 3.0	0.75 - 1.5
Jerusalem artichoke	2.3 - 3.75	1.5
Johnsongrass	1.5 - 2.3	0.75
Kikuyugrass	1.5 - 2.3	0.75
Knapweed	3.0	1.5
Lantana	-	0.75 - 1.0
Lespedeza	2.3 - 3.75	1.5
Loosestrife, purple	2.0	1.0 - 1.5
Lotus, American	2.0	0.75
Maidencane	3.0	0.75
Milkweed, common	2.3	1.5
Muhly, wirestem	1.5 - 2.3	0.75
Mullein, common	2.3 - 3.75	1.5
Napiergrass	2.3 - 3.75	1.5
Nightshade, silverleaf	3.0 - 3.75	1.5
Nutsedge; purple, yellow	2.3	0.75
Orchardgrass	1.5 - 2.3	0.75
Pampasgrass	2.3 - 3.75	1.5

WEED SPECIES	RATE (QT/A)	HAND-HELD % SOLUTION
Paragrass	3.0	0.75
Pepperweed, perennial	3.0	1.5
Phragmites*	2.0 - 3.75	0.75 - 1.5
Quackgrass	1.5 - 2.3	0.75
Redvine*	1.5	1.5
Reed, giant ( <i>Arundo donax</i> )	3.0 - 3.75	1.5
Ryegrass, perennial	1.5 - 2.3	0.75
Salvinia, giant	3.0 - 3.75	2.0
Smartweed, swamp	2.3 - 3.75	1.5
Spatterdock	3.0	0.75
Spurge, leafy*	-	1.5
Starthistle, yellow	-	1.5
Sweet potato, wild*	-	1.5
Thistle, artichoke	1.5 - 2.3	2.0
Thistle, Canada	1.5 - 2.3	1.5
Timothy	1.5 - 2.3	1.5
Torpedograss*	3.0 - 3.75	0.75 - 1.5
Trumpet creeper*	1.5 - 2.3	1.5
Tules, common	-	1.5
Vaseygrass	2.3 - 3.75	1.5
Velvetgrass	2.3 - 3.75	1.5
Waterhyacinth	2.5 - 3.0	0.75 - 1.0
Waterlettuce	-	0.75 - 1.0
Waterprimrose	-	0.75
Wheatgrass, western	1.5 - 2.3	0.75

\*Partial control

**Alligatorweed**—Apply 3 quarts of this product per acre as a broadcast spray or as a 1.3-percent solution with hand-held equipment to provide partial control of alligatorweed. Apply when most of the target plants are in bloom. Repeat applications will be required to maintain such control.

**Beachgrass, European**—Apply an 8-percent solution of this products plus 0.5- to 1.5-percent nonionic surfactant on a low-volume spray-to-wet basis. Best results are obtained when applications are made when European beachgrass is actively growing through the boot to the full heading stages of growth. Make applications prior to the loss of more than 50 percent green leaf color in the fall. Do not treat when weeds are under drought stress. Repeat applications may be necessary.

**Bermudagrass**—Apply 4 quarts of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Apply when target plants are actively growing and when seed heads appear.

**Bindweed, field / Silverleaf Nightshade / Texas Blueweed**—Apply 3 to 3.75 quarts of this product per acre as a broadcast spray west of the Mississippi River and 2.3 to 3 quarts of this product per acre east of the Mississippi River. With hand-held equipment, use a 1.5-percent solution. Apply when target plants are actively growing and are at or beyond full bloom. For silverleaf nightshade, best results can be obtained when application is made after berries are formed. Do not treat when weeds are under drought stress. New leaf development indicates active growth. For best results apply in late summer or fall.

**Brackenfern**—Apply 2.3 to 3 quarts of this product per acre as a broadcast spray or as a 0.75- to 1-percent solution with hand-held equipment. Apply to fully expanded fronds which are at least 18 inches long.

**Cattail**—Apply 2.3 to 3 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Apply when target plants are actively growing and are at or beyond the early-to-full bloom stage of growth. Best results are achieved when application is made during the summer or fall months.

**Cogongrass**—Apply 2.3 to 3.75 quarts of this product per acre as a broadcast spray. Apply when cogongrass is at least 18 inches tall and actively growing in late summer or fall. Allow 7 or more days after application before tillage or mowing. Due to uneven stages of growth and the dense nature of vegetation preventing good spray coverage, repeat treatments may be necessary to maintain control.

**Cordgrass**—Apply 2.3 to 3.75 quarts of this product per acre as a broadcast spray or as a 1- to 2-percent solution with hand-held equipment. Schedule applications in order to allow 6 hours before treated plants are covered by tidewater. The presence of debris and silt on the cordgrass plants will reduce performance. It may be necessary to wash targeted plants prior to application to improve uptake of this product into the plant.

**Cutgrass, giant**—Apply 3 quarts of this product per acre as a broadcast spray or as a 1-percent solution with hand-held equipment to provide partial control of giant cutgrass. Repeat applications will be required to maintain such control, especially where vegetation is partially submerged in water. Allow for substantial regrowth to the 7- to 10-leaf stage prior to retreatment.

**Dogbane, hemp / Knapweed / Horseradish**—Apply 3 quarts of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the late bud-to-flower stage of growth. For best results, apply in late summer or fall.

**Fescue, tall**—Apply 2.3 quarts of this product per acre as a broadcast spray or as a 1-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the boot-to-head stage of growth. When applied prior to the boot stage, less desirable control may be obtained.

**Guineagrass**—Apply 2.3 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Apply when target plants are actively growing and when most have reached at least the 7-leaf stage of growth.

**Johnsongrass / Bluegrass, Kentucky / Bromegrass, smooth / Canarygrass, reed / Orchardgrass / Ryegrass, perennial / Timothy / Wheatgrass, western**—Apply 1.5 to 2.3 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the boot-to-head stage of growth. When applied prior to the boot stage, less desirable control may be obtained. In the fall, apply before plants have turned brown.

**Lantana**—Apply this product as a 0.75- to 1-percent solution with hand-held equipment. Apply to actively growing lantana at or beyond the bloom stage of growth. Use the higher application rate for plants that have reached the woody stage of growth.

**Loosestrife, purple**—Apply 2 quarts of this product per acre as a broadcast spray or as a 1- to 1.5-percent solution using hand-held equipment. Treat when plants are actively growing at or beyond the bloom stage of growth. Best results are achieved when application is made during summer or fall months. Fall treatments must be applied before a killing frost.

**Lotus, American**—Apply 2 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Treat when plants are actively growing at or beyond the bloom stage of growth. Best results are achieved when application is made during summer or fall months. Fall treatments must be applied before a killing frost. Repeat treatment may be necessary to control regrowth from underground parts and seeds.

**Maidencane / Paragrass**—Apply 3 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Repeat treatments will be required, especially to vegetation partially submerged in water. Under these conditions, allow for regrowth to the 7- to 10-leaf stage prior to retreatment.

**Milkweed, common**—Apply 2.3 quarts of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the late bud-to-flower stage of growth.

**Nutsedge, purple, yellow**—Apply 2.3 quarts of this product per acre as a broadcast spray, or as a 0.75-percent solution with hand-held equipment to control existing nutsedge plants and immature outlets attached to treated plants. Apply when target plants are in flower or when new outlets can be found at rhizome tips. Outlets which have not germinated will not be controlled and may germinate following treatment. Repeat treatments will be required for long-term control.

**Pampasgrass**—Apply a 1.5-percent solution of this product with hand-held equipment when plants are actively growing.

**Phragmites**—For partial control of phragmites in Florida and the counties of other states bordering the Gulf of Mexico, apply 3.75 quarts per acre as a broadcast spray or apply a 1.5-percent solution with hand-held equipment. In other areas of the U.S., apply 2 to 3 quarts per acre as a broadcast spray or apply a 0.75-percent solution with hand-held equipment for partial control. For best results, treat during late summer or fall months when plants are actively growing and in full bloom. Due to the dense nature of the vegetation, which may prevent good spray coverage and uneven stages of growth, repeat treatments may be necessary to maintain control. Visual control symptoms will be slow to develop.

**Quackgrass / Kikuyugrass / Muhly, wirestem**—Apply 1.5 to 2.3 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment when most quackgrass or wirestem muhly is at least 8 inches in height (3- to 4-leaf stage of growth) and actively growing. Allow 3 or more days after application before tillage.

**Reed, giant / Ice Plant**—For control of giant reed and ice plant, apply a 1.5-percent solution of this product with hand-held equipment when plants are actively growing. For giant reed, best results are obtained when applications are made in late summer to fall.

**Salvinia, giant**—Apply as a 2.0% v/v spray-to-wet solution with 0.5 to 2.0% v/v of a nonionic surfactant containing at least 70% active ingredient. For broadcast applications, apply 3 to 3.75 quarts of this product with an aquatic approved surfactant system containing 0.1% v/v nonionic organosilicone and 0.25% v/v nonionic spreader sticker surfactant in 3 to 40 gallons per acre as a broadcast treatment.

**Spatterdock**—Apply 3 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Apply when most plants are in full bloom. For best results, apply during the summer or fall months.

**Sweet potato, wild**—Apply this product as a 1.5-percent solution using hand-held equipment. Apply to actively growing weeds that are at or beyond the bloom stage of growth. Repeat applications will be required. Allow the plant to reach the specified stage of growth before retreatment.

**Thistle, Canada, artichoke**—Apply 1.5 to 2.3 quarts of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment for Canada thistle. To control artichoke thistle, apply a 2-percent solution as a spray-to-wet application. Apply when target plants are actively growing and are at or beyond the bud stage of growth.

**Torpedograss**—Apply 3 to 3.75 quarts of this product per acre as a broadcast spray or as a 0.75- to 1.5-percent solution with hand-held equipment to provide partial control of torpedograss. Use the lower rates under terrestrial conditions, and the higher rates under partially submerged or a floating mat condition. Repeat treatments will be required to maintain such control.

**Tules, common**—Apply this product as a 1.5-percent solution with hand-held equipment. Apply to actively growing plants at or beyond the seedhead stage of growth.

After application, visual symptoms will be slow to appear and may not occur for 3 or more weeks.

**Waterhyacinth**—Apply 2.5 to 3 quarts of this product per acre as a broadcast spray or apply a 0.75- to 1-percent solution with hand-held equipment. Apply when target plants are actively growing and at or beyond the early bloom stage of growth. After application, visual symptoms may require 3 or more weeks to appear with complete necrosis and decomposition usually occurring within 60 to 90 days. Use the higher rates when more rapid visual effects are desired.

**Waterlettuce**—For control, apply a 0.75- to 1-percent solution of this product with hand-held equipment to actively growing plants. Use higher rates where infestations are heavy. Best results are obtained from mid-summer through winter applications. Spring applications may require retreatment.

**Waterprimrose**—Apply this product as a 0.75-percent solution using hand-held equipment. Apply to plants that are actively growing at or beyond the bloom stage of growth, but before fall color changes occur. Thorough coverage is necessary for best control.

**Other perennials listed on this label**—Apply 2.3 to 3.75 quarts of this product per acre as a broadcast spray or as a 0.75- to 1.5-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached early head or early bud stage of growth.

## 9.3 Woody Brush and Trees

Apply this product after full leaf expansion, unless otherwise directed. Use the higher rate for larger plants and/or dense areas of growth. On vines, use the higher rate for plants that have reached the woody stage of growth. Best results are obtained when application is made in late summer or fall after fruit formation.

In arid areas, best results are obtained when applications are made in the spring to early summer when brush species are at high moisture content and are flowering.

Ensure thorough coverage when using spray-to-wet treatments using hand-held equipment. When using hand-held equipment for low-volume directed-spray spot treatments, apply a 4- to 8-percent solution of this product.

Symptoms may not appear prior to frost or senescence with fall treatments.

Allow 7 or more days after application before tillage, mowing or removal. Repeat treatments may be necessary to control plants regenerating from underground parts or seed. Some autumn colors on undesirable deciduous species are acceptable provided no major leaf drop has occurred. Reduced performance may result if fall treatments are made following a frost.

WEED SPECIES	BROADCAST RATE (QT/A)	HAND-HELD SPRAY-TO-WET % SOLUTION
Alder	2.3-3.0	0.75-1.2
Ash*	1.5-3.75	0.75-1.5
Aspen, quaking	1.5-2.3	0.75-1.2
Bearclover (Bearmat)*	1.5-3.75	0.75-1.5
Beech*	1.5-3.75	0.75-1.5
Birch	1.5	0.75
Blackberry	2.3-3.0	0.75-1.2
Blackgum	1.5-3.75	0.75-1.5
Bracken	1.5-3.75	0.75-1.5
Broom; French, Scotch	1.5-3.75	1.2-1.5
Buckwheat, California*	1.5-3.0	0.75-1.5
Cascara*	1.5-3.75	0.75-1.5
Castorbean	-	1.5
Catsclaw*	-	1.2-1.5
Ceanothus*	1.5-3.75	0.75-1.5
Chamise*	1.5-3.75	0.75
Cherry; bitter, black, pin	1.5-3.75	1.0-1.5
Cottonwood, eastern	1.5-3.75	0.75-1.5
Coyote brush	2.3-3.0	1.2-1.5
Cypress; swamp, bald	1.5-3.75	0.75-1.5
Deerweed	1.5-3.75	0.75-1.5
Dewberry	2.3-3.0	0.75-1.2
Dogwood*	3.0-3.75	1.0-2.0
Elderberry	1.5	0.75
Elm*	1.5-3.75	0.75-1.5
Eucalyptus	-	1.5
Gallberry	1.5-3.75	0.75-1.5
Grorse*	1.5-3.75	0.75-1.5
Hackberry, western	1.5-3.75	0.75-1.5
Hasardia*	1.5-3.0	0.75-1.5
Hawthorn	1.5-2.3	0.75-1.2
Hazel	1.5	0.75
Hickory*	3.0-3.75	1.0-2.0
Honeysuckle	2.3-3.0	0.75-1.2
Hornbeam, American*	1.5-3.75	0.75-1.5
Huckleberry	1.5-3.75	0.75-1.5
Ivy, poison	3.0-3.75	1.5

Knotweed; Bohemian, Giant, Japanese**	-	-
Kudzu	3.0	1.5
Locust, black*	1.5-3.0	0.75-1.5
Madrone resprouts*	-	1.5
Magnolia, sweetbay	1.5-3.75	0.75-1.5
Manzanita*	1.5-3.75	0.75-1.5
Maple, red	1.0-3.75	0.75-1.2
Maple, sugar	-	0.75-1.2
Maple, vine*	1.5-3.75	0.75-1.5
Monkey flower*	1.5-3.0	0.75-1.5
Oak; black, white*	1.5-3.0	0.75-1.5
Oak; northern, pin	1.5-3.0	0.75-1.2
Oak, poison	3.0-3.75	1.5
Oak, post	2.3-3.0	0.75-1.2
Oak, red	-	0.75-1.2
Oak, scrub*	1.5-3.0	0.75-1.5
Oak, southern red	1.5-3.75	1.0-1.5
Orange, Osage	1.5-3.75	0.75-1.5
Peppertree, Brazilian (Florida holly)*	1.5-3.75	1.5
Persimmon*	1.5-3.75	0.75-1.5
Pine	1.5-3.75	0.75-1.5
Poplar, yellow*	1.5-3.75	0.75-1.5
Prunus	1.5-3.75	1.0-1.5
Raspberry	2.3-3.0	0.75-1.2
Redbud, eastern	1.5-3.75	0.75-1.5
Redcedar, eastern	1.5-3.75	0.75-1.5
Rose, multiflora	1.5	0.75
Russian olive*	1.5-3.75	0.75-1.5
Sage, black	1.5-3.0	0.75
Sage, white*	1.5-3.0	0.75-1.5
Sage brush, California	1.5-3.0	0.75
Salmonberry	1.5	0.75
Saltbush	-	1.0
Saltcedar**	1.5-3.75	0.75-1.5
Sassafras*	1.5-3.75	0.75-1.5
Sea Myrtle	-	1.0
Sourwood*	1.5-3.75	0.75-1.5
Sumac; laurel, poison, smooth, sugarbush, winged*	1.5-3.0	0.75-1.5
Sweetgum	1.5-2.3	0.75-1.5
Swordfern*	1.5-3.75	0.75-1.5
Tallowtree, Chinese	-	0.75
Tan oak resprouts*	-	1.5
Thimbleberry	1.5	0.75
Tobacco, tree*	1.5-3.0	0.75-1.5
Toyon*	-	1.5
Trumpetcreeper	1.5-2.3	0.75-1.2
Vine maple*	1.5-3.75	0.75-1.5
Virginia creeper	1.5-3.75	0.75-1.5
Waxmyrtle, southern*	1.5-3.75	1.5
Willow	2.3	0.75
Yerba Santa, California*	-	1.5

\*Partial control

\*\*Refer to specific instructions below

**Alder / Blackberry / Dewberry / Honeysuckle / Oak, Post / Raspberry**—For control, apply 2.3 to 3 quarts per acre as a broadcast spray or as a 0.75- to 1.2-percent solution with hand-held equipment.

**Aspen, Quaking / Hawthorn / Trumpetcreeper**—For control, apply 1.5 to 2.3 quarts of this product per acre as a broadcast spray or as a 0.75- to 1.2-percent solution with hand-held equipment.

**Birch / Elderberry / Hazel / Salmonberry / Thimbleberry**—For control, apply 1.5 quarts per acre of this product as a broadcast spray or as a 0.75-percent solution with hand-held equipment.

**Broom: French, Scotch**—For control, apply a 1.2- to 1.5-percent solution with hand-held equipment.

**Buckwheat, California / Hasardia / Monkey Flower / Tobacco, Tree**—For partial control of these species, apply a 0.75- to 1.5-percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.

**Castorbean**—For control, apply a 1.5-percent solution of this product with hand-held equipment.

**Catsclaw**—For partial control, apply a 1.2- to 1.5-percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

**Cherry: Bitter, Black, Pin / Oak, Southern Red / Sweet Gum / Prunus**—For control, apply 1.5 to 3.75 quarts of this product per acre as a broadcast spray or as a 1- to 1.5-percent solution with hand-held equipment.

**Coyote brush**—For control, apply a 1.2- to 1.5-percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

**Dogwood / Hickory**—For partial control, apply a 1- to 2-percent solution of this product with hand-held equipment or 3 to 3.75 quarts per acre as a broadcast spray.

**Eucalyptus, Bluegum**—For control of eucalyptus resprouts, apply a 1.5-percent solution of this product with hand-held equipment when resprouts are 6- to 12-feet tall. Ensure complete coverage. Apply when plants are actively growing. Avoid application to drought-stressed plants.

**Knottweed: Bohemian, Giant, Japanese (*Polygonum bohemicum*, *P. sachalinense* and *P. cuspidatum*)**

**Stem Injection.** See the "Hollow Stem Injection" section of this label.

**Cut Stem.** Cut stems cleanly just below the 2<sup>nd</sup> or 3<sup>rd</sup> node above the ground. Immediately apply 0.36 fluid ounce (10 mLs) of a 50-percent solution of this product into the 'well' or remaining internode. Ensure that removed upper plant material is carefully gathered and discarded so that it will not contact soil and regenerate plants from sprouting buds. Use of a bio-barrier such as cardboard, plywood or plastic sheeting is recommended.

The combined total for all treatments must not exceed 8 quarts per acre. At 10 mL of a 50-percent solution, approximately 1500 stems per acre may be treated.

**Kudzu**—For control, apply 3 quarts of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Repeat applications will be required to maintain control.

**Maple, Red**—For control, apply as a 0.75- to 1.2-percent solution with hand-held equipment when leaves are fully developed. For partial control, apply 1 to 3.75 quarts of this product per acre as a broadcast spray.

**Maple, Sugar / Oak: Northern, Pin, Red**—For control, apply as a 0.75- to 1.2-percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

**Peppertree, Brazilian (Holly, Florida) / Waxmyrtle, Southern**—For partial control, apply this product as a 1.5-percent solution with hand-held equipment.

**Poison Ivy / Poison Oak**—For control, apply 3 to 3.75 quarts of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Repeat applications may be required to maintain control. Fall treatments must be applied before leaves lose green color.

**Rose, Multiflora**—For control, apply 1.5 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Treatments should be made prior to leaf deterioration by leaf-feeding insects.

**Sage, Black / Sagebrush, California / Chamise / Tallowtree, Chinese**—For control of these species, apply a 0.75-percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.

**Saltbush, Sea myrtle**—For control, apply this product as a 1-percent solution with hand-held equipment.

**Saltcedar**—For partial control, apply a 1- to 2-percent solution of this product with hand-held equipment or 3 to 3.75 quarts per acre as a broadcast spray. For control, apply a 1- to 2-percent solution of this product mixed with 0.25 percent Arsenal with hand-held equipment. For control using broadcast applications, apply 1.5 quarts of this product in a tank-mix with 1 pint of Arsenal to plants less than 6 feet tall. To control saltcedar greater than 6 feet tall using broadcast applications, apply 3 quarts of this product in a tank-mix with 2 pints of Arsenal.

**Willow**—For control, apply 2.3 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment.

**Other woody brush and trees listed in this label**—For partial control, apply 1.5 to 3.75 quarts of this product per acre as a broadcast spray or as a 0.75- to 1.5-percent solution with hand-held equipment.

## 10.0 LIMIT OF WARRANTY AND LIABILITY

Monsanto Company warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes set forth in the Complete Directions for Use label booklet ("Directions") when used in accordance with those Directions under the conditions described therein. NO OTHER EXPRESS WARRANTY OR IMPLIED WARRANTY OF FITNESS FOR PARTICULAR PURPOSE OR MERCHANTABILITY IS MADE. This warranty is also subject to the conditions and limitations stated herein.

Buyer and all users shall promptly notify this Company of any claims whether based in contract, negligence, strict liability, other tort or otherwise.

To the fullest extent permitted by law, buyer and all users are responsible for all loss or damage from use or handling which results from conditions beyond the control of this Company, including, but not limited to, incompatibility with products other than those set forth in the Directions, application to or contact with desirable vegetation, unusual weather, weather conditions which are outside the range considered normal at the application site and for the time period when the product is applied, as well as weather conditions which are outside the application ranges set forth in the Directions, application in any manner not explicitly set forth in the Directions, moisture conditions outside the moisture range specified in the Directions, or the presence of products other than those set forth in the Directions in or on the soil, crop or treated vegetation.

This Company does not warrant any product reformulated or repackaged from this product except in accordance with this Company's stewardship requirements and with express written permission from this Company.

THE EXCLUSIVE REMEDY OF THE USER OR BUYER, AND THE LIMIT OF THE LIABILITY OF THIS COMPANY OR ANY OTHER SELLER FOR ANY AND ALL LOSSES, INJURIES OR DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT (INCLUDING CLAIMS BASED IN CONTRACT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT OR OTHERWISE) SHALL BE THE PURCHASE PRICE PAID BY THE USER OR BUYER FOR THE QUANTITY OF THIS PRODUCT INVOLVED, OR, AT THE ELECTION OF THIS COMPANY OR ANY OTHER SELLER, THE REPLACEMENT OF SUCH QUANTITY, OR, IF NOT ACQUIRED BY PURCHASE, REPLACEMENT OF SUCH QUANTITY, TO THE FULLEST EXTENT PERMITTED BY LAW, IN NO EVENT SHALL THIS COMPANY OR ANY OTHER SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES.

Upon opening and using this product, buyer and all users are deemed to have accepted the terms of this LIMIT OF WARRANTY AND LIABILITY which may not be varied by any verbal or written agreement. If terms are not acceptable, return at once unopened.

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061709



# Specimen Label



# DMA<sup>®</sup> 4 VM

## Herbicide

For selective control of many broadleaf weeds in forests, ornamental turfgrass, non-cropland and aquatic areas. Also for control of trees by injection.

### Active Ingredient:

2,4-Dichlorophenoxyacetic acid, dimethylamine salt .....46.3%

Other Ingredients.....53.7%

Total.....100.0%

2,4-dichlorophenoxyacetic acid - 38.4% - 3.8 lb/gal

EPA Reg. No. 62719-3

## Keep Out of Reach of Children

# DANGER PELIGRO

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

### Agricultural Use Requirements

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR Part 170. Refer to the label booklet under "Agricultural Use Requirements" in the Directions for Use section for information about this standard.

Refer to inside of label booklet for Directions for Use.

**Notice:** Read the entire label. Use only according to label directions.

**Before using this product, read Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies at end of label booklet. If terms are unacceptable, return at once unopened.**

In case of emergency endangering health or the environment involving this product, call 1-800-992-5994.

Agricultural Chemical: Do not ship or store with food, feeds, drugs or clothing.

### Precautionary Statements

#### Hazards to Humans and Domestic Animals

# DANGER

**Corrosive • Causes Irreversible Eye Damage • Harmful If Swallowed, Inhaled Or Absorbed Through The Skin**

**Do not get in eyes, on skin, or on clothing. Avoid breathing vapor or spray mist. Wash thoroughly with soap and water after handling.**

#### Personal Protective Equipment (PPE)

Some materials that are chemical-resistant to this product are made of any waterproof material. If you want more options, follow the instructions for category A on an EPA chemical resistance category selections chart.

#### All pilots must wear:

- Long-sleeved shirt and long pants
- Shoes plus socks

#### All mixers, loaders, flaggers, other applicators and handlers must wear:

- Long-sleeved shirt and long pants
- Shoes plus socks
- Chemical-resistant gloves
- Protective eyewear
- Chemical resistant apron when mixing or loading, cleaning up spills or equipment, or otherwise exposed to the concentrate

See engineering controls for additional requirements.

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

### Engineering Controls

When handlers use closed systems or enclosed cabs in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240 (d)(4-6)], the handler PPE requirements may be reduced or modified as specified in the WPS.

Pilots must use an enclosed cockpit that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240 (d)(4-6)].

### User Safety Recommendations

Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
- Remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

### First Aid

**If in eyes:** Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

**If on skin or clothing:** Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.

**If swallowed:** Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by the poison control center or doctor. Do not give anything by mouth to an unconscious person.

**If inhaled:** Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment advice.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment.

**Note to Physician:** Probable mucosal damage may contraindicate the use of gastric lavage.

### Environmental Hazards

This product is toxic to fish and aquatic invertebrates. For terrestrial uses: Do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark. Drift or runoff may adversely affect aquatic invertebrates and non-target plants. Drift and runoff may be hazardous to aquatic organisms in water adjacent to treated areas. Do not contaminate water when disposing of equipment washwaters or rinsate.

This chemical has properties and characteristics associated with chemicals detected in groundwater. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination. Application around a cistern or well may result in contamination of drinking water or groundwater.

**Aquatic Weed Control:** Fish breathe dissolved oxygen in the water and decaying weeds also use oxygen. When treating continuous, dense weed masses, it may be appropriate to treat only part of the infestation at a time. For example, apply the product in lanes separated by untreated strips that can be treated after vegetation in treated lanes has disintegrated. During the growing season, weeds decompose in a 2 to 3 week period following treatment. Begin treatment along the shore and proceed outwards in bands to allow fish to move into untreated areas. Waters having limited and less dense weed infestations may not require partial treatments.

### Directions for Use

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Read all Directions for Use carefully before applying.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your state or tribe, consult the agency responsible for pesticide regulation.

### Agricultural Use Requirements

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR Part 170. This Standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE), and restricted-entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 48 hours.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water, is:

- Coveralls
- Chemical-resistant gloves made of any waterproof material
- Shoes plus socks
- Protective eyewear

### Non-Agricultural Use Requirements

The requirements in this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard for Agricultural Pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries, or greenhouses.

**Entry Restrictions for Non-WPS Uses:** Do not enter or allow people (or pets) to enter the treated area until sprays have dried.

### Storage and Disposal

Do not contaminate water, food, or feed by storage or disposal.

**Pesticide Storage:** Keep container tightly closed when not in use. If exposed to subfreezing temperatures, the product should be warmed to at least 40°F and mixed thoroughly before using.

**Pesticide Disposal:** Pesticide wastes are toxic. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal law and may contaminate groundwater. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste Representative at the nearest EPA Regional Office for guidance.

#### Nonrefillable containers 5 gallons or less:

**Container Handling:** Nonrefillable container. Do not reuse or refill this container.

Triple rinse or pressure rinse container (or equivalent) promptly after emptying. **Triple rinse** as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container 1/4 full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. **Pressure rinse** as follows: Empty the remaining contents into application equipment or a mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 psi for at least 30 seconds. Drain for 10 seconds after the flow begins to drip. Then offer for recycling if available or puncture and dispose of in a sanitary landfill, or by incineration, or by other procedures allowed by state and local authorities.

#### Refillable containers larger than 5 gallons:

**Container Handling:** Refillable container. Refill this container with pesticide only. Do not reuse this container for any other purpose. Cleaning the container before final disposal is the responsibility of the person disposing of the container. Cleaning before refilling is the responsibility of the refiller. To clean the container before final disposal, empty the remaining contents from this container into application equipment or a mix tank. Fill the container about 10% full with water and, if possible, spray all sides while adding water. If practical, agitate vigorously or recirculate water with the pump for two minutes. Pour or pump rinsate into application equipment or rinsate collection system. Repeat this rinsing procedure two more times. Then offer for recycling if available, or puncture and dispose of in a sanitary landfill, or by incineration, or by other procedures allowed by state and local authorities.

#### Nonrefillable containers 5 gallons or larger:

**Container Handling:** Nonrefillable container. Do not reuse or refill this container.

Triple rinse or pressure rinse container (or equivalent) promptly after emptying. **Triple rinse** as follows: Empty the remaining contents into

### Storage and Disposal (Cont.)

application equipment or a mix tank. Fill the container 1/4 full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two more times. **Pressure rinse** as follows: Empty the remaining contents into application equipment or a mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 psi for at least 30 seconds. Drain for 10 seconds after the flow begins to drip. Then offer for recycling if available, or puncture and dispose of in a sanitary landfill, or by incineration, or by other procedures allowed by state and local authorities.

### Product Information

DMA® 4 IVM herbicide is intended for selective control of many broadleaf weeds in forests, ornamental turfgrass, non-cropland and aquatic areas. Also for control of trees by injection.

Apply DMA 4 IVM as a water or oil-water spray during warm weather when target weeds or woody plants are actively growing. Application under drought conditions will often give poor results. Use low spray pressure to minimize drift. Generally, the lower dosages specified on this label will be satisfactory for young, succulent growth of susceptible weed species. For less susceptible species and under conditions where control is more difficult, use higher specified rates. Deep-rooted perennial weeds such as Canada thistle and field bindweed and many woody plants usually require repeated applications for satisfactory control. Consult your State Agricultural Experiment stations or Extension Service Weed Specialists for recommendations from this label that best fit local conditions.

### Use Precautions and Restrictions

Be sure that use of DMA 4 IVM conforms to all application regulations.

**Chemigation:** Do not apply this product through any type of irrigation system.

Excessive amounts of 2,4-D in the soil may temporarily inhibit seed germination and plant growth.

Use of this product in certain portions of California, Oregon, and Washington is subject to the January 22, 2004 Order for injunctive relief in *Washington Toxics Coalition et al. v. EPA*, C01-0132C, (W.D. W.A.). For further information, please refer to EPA website: <http://www.epa.gov/espp/litstatus/wtc/index.htm>.

### Spray Drift Management

A variety of factors including weather conditions (e.g., wind direction, wind speed, temperature, relative humidity) and method of application (e.g., ground, aerial, airblast) can influence pesticide drift. The applicator must evaluate all factors and make appropriate adjustments when applying this product.

#### Droplet Size

When applying sprays that contain 2,4-D as the sole active ingredient, or when applying sprays that contain 2,4-D mixed with active ingredients that require a coarse or coarser spray, apply only as a coarse or coarser spray (ASABE Standard 572) or a volume mean diameter of 385 microns or greater for spinning atomizer nozzles.

When applying sprays that contain 2,4-D mixed with other active ingredients that require a medium or more fine spray, apply only as a medium or coarser spray (ASABE Standard 572) or a volume mean diameter of 300 microns or greater for spinning atomizer nozzles.

#### Wind Speed

Do not apply at wind speeds greater than 15 mph. Only apply this product if the wind direction favors on-target deposition and there are not sensitive areas (including residential areas, bodies of water, known habitat for nontarget species, nontarget crops) within 250 feet downwind. If applying a medium spray, leave one swath unsprayed at the downwind edge of the treated field.

#### Temperature Inversions

If applying at wind speeds less than 3 mph, the applicator must determine if: a) conditions of temperature inversion exist, or b) stable atmospheric conditions exist at or below nozzle height. Do not make applications into areas of temperature inversions or stable atmospheric conditions.

#### Susceptible Plants

Do not apply under circumstances where spray drift may occur to food, forage, or other plantings that might be damaged or crops thereof rendered unfit for sale, use or consumption. Susceptible crops include

cotton, okra, flowers, fruit trees, grapes (in growing stage), fruit trees (foliage), soybeans (vegetative stage), ornamentals, sunflowers, tomatoes, beans, and other vegetables, or tobacco. Small amounts of spray drift that may not be visible may injure susceptible broadleaf plants.

**Other State and Local Requirements**

Applicators must follow all state and local pesticide drift requirements regarding application of 2,4-D herbicides. Where states have more stringent regulations, they must be observed.

**Equipment**

All aerial and ground application equipment must be properly maintained and calibrated using appropriate carriers or surrogates.

**Aerial Application**

The boom length must not exceed 75% of the wingspan or 90% of the rotor blade diameter.

Release spray at the lowest height consistent with efficacy and flight safety. Do not release spray at a height greater than 10 feet above the crop canopy unless a greater height is required for aircraft safety. This requirement does not apply to forestry or rights-of-way applications.

When applications are made with a crosswind, the swath will be displaced downwind. The applicator must compensate for this by adjusting the path of the aircraft upwind.

**Groundboom Application**

Do not apply with a nozzle height greater than 4 feet above the crop canopy.

**Mixing**

Mix DMA 4 IVM only with water unless otherwise directed on this label. Add about half of the water to the mixing tank, then add the DMA 4 IVM with agitation, and finally the rest of the water with continuing agitation.

**Note:** Adding oil, wetting agent, or other surfactant to the spray mixture may increase effectiveness on weeds, but also may reduce selectivity to crops resulting in crop damage.

**Tank Mixing:** When tank mixing, read and follow the label of each tank mix product used for precautionary statements, directions for use, weeds controlled, and geographic and other restrictions. Use in accordance with the most restrictive of label limitations and precautions. Do not exceed any active ingredient's maximum use rates when tank mixing. Do not tank mix this product with any product containing a label prohibition against tank mixing with 2,4-D.

**Tank Mix Compatibility Testing:** A jar test is recommended prior to tank mixing to ensure compatibility of this product and other pesticides. Use a clear glass quart jar with lid and mix the tank mix ingredients in their relative proportions. Invert the jar containing the mixture several times and observe the mixture for approximately 1/2 hour. If the mixture balls-up, forms flakes, sludges, jels, oily films or layers, or other precipitates, it is not compatible and the tank mix combination should not be used.

**Mixing with Liquid Nitrogen Fertilizer**

This product may be combined with liquid nitrogen fertilizer suitable for foliar application to accomplish broadleaf weed control and fertilization of corn, small grains or pastures in a single operation. Use DMA 4 IVM in accordance with directions for these crops provided in this label. Use liquid fertilizer at rates recommended by the supplier or Extension Service Specialist. Test for mixing compatibility as describe above before mixing in spray tank. A compatibility aid such as Unite or Compex may be needed in some situations. Compatibility is best with liquid fertilizer solutions containing only nitrogen. Mixing with N-P-K solutions may not be satisfactory, even with the addition of a compatibility aid. Pre-mixing

1 part DMA 4 IVM with up to 4 parts water may help in situations when mixing difficulty occurs.

Fill the tank about half full with the liquid fertilizer, then add the required amount of DMA 4 IVM with agitation. Maintain agitation and complete filling the tank with liquid fertilizer. Apply immediately and continue agitation in spray tank during application. **Do not store the spray mixture.** Application during very cold weather (near freezing) is not advisable.

**Sprayer Clean-Out**

To avoid injury to desirable plants, equipment used to apply this product should be thoroughly cleaned before re-use or applying other chemicals.

1. Rinse and flush application equipment thoroughly after use at least three times with water. Dispose of all rinse water by application to treatment area or apply to non-cropland area away from water supplies.
2. During the second rinse, add 1 quart of household ammonia for every 25 gallons of water. Circulate the solution through the entire system so that all internal surfaces are contacted (15 to 20 min). Let the solution stand for several hours, preferably overnight.
3. Flush the solution out of the spray tank through the boom.
4. Rinse the system twice with clean water, recirculating and draining each time.
5. Remove nozzles and screens and clean separately.
6. If equipment is to be used to apply another pesticide or agricultural chemical to a 2,4-D susceptible crop, additional steps may be required to remove all traces of 2,4-D, including cleaning of disassembled parts and replacement of hoses or other fittings that may contain absorbed 2,4-D.

**Application**

Apply with calibrated air or ground equipment using sufficient spray volume to provide adequate coverage of target weeds or as otherwise directed in specific use directions. For broadcast application, use a spray volume of 3 gallons or more per acre by air and 10 gallons or more per acre for ground equipment. Where states have regulations which specify minimum spray volumes, they should be observed. In general, spray volume should be increased as crop canopy, height and weed density increase in order to obtain adequate spray coverage. **Do not apply less than 3 gallons total spray volume per acre.**

**Rate Ranges and Application Timing**

The lower dosages given will be satisfactory for young, succulent growth of sensitive weed species. For less sensitive species and under conditions where control is more difficult, the higher dosages will be needed. Apply DMA 4 IVM during warm weather when weeds are young and actively growing.

**Spot Treatments**

To prevent misapplication, spot treatments should be applied with a calibrated boom or with hand sprayers using a fixed spray volume per 1000 sq ft as indicated below.

**Hand-Held Sprayers:** Hand-held sprayers may be used for spot applications of DMA 4 IVM. Care should be taken to apply the spray uniformly and at a rate equivalent to a broadcast application. Application rates in the table are based upon the application rate for an area of 1000 sq ft. Mix the amount of DMA 4 IVM (fl oz or ml) corresponding to the desired broadcast rate in 1 to 3 gallons of spray. To calculate the amount of DMA 4 IVM required for larger areas, multiply the table value (fl oz or ml) by the thousands of sq ft to be treated. An area of 1000 sq ft is approximately 10.5 X 10.5 yards (strides) in size.

**Rate Conversion Table for Spot Treatment:**

Label Broadcast Rate (pint/acre)							
1/2	2/3	3/4	1	2	3	4	8
Equivalent Amount of DMA 4 IVM per 1000 sq ft							
1/5 fl oz <sup>1</sup> (5.5 ml)	1/4 fl oz (7.3 ml)	1/3 fl oz (8.3 ml)	3/8 fl oz (11 ml)	3/4 fl oz (22 ml)	1 fl oz (33 ml)	1 1/2 fl oz (44 ml)	3 fl oz (88 ml)

<sup>1</sup>Conversion factors: 1 fl oz = 29.6 (30) ml

**Band Application:** DMA 4 IVM may be applied as a band treatment. Use the formulas below to determine the appropriate rate and volume per treated acre.

Band width in inches	X	Broadcast rate =	Band rate per treated acre
Row width in inches			
Band width in inches	X	Broadcast volume =	Band volume per treated acre
Row width in inches			

## Weeds Controlled

### Annual or Biennial Weeds

beggarticks<sup>1</sup>  
 bittercress, smallflowered  
 bitterweed  
 broomweed, common<sup>1</sup>  
 burdock, common  
 buttercup, smallflowered<sup>1</sup>  
 carpetweed  
 cinquefoil, common  
 cinquefoil, rough  
 cocklebur, common  
 coffeeweed  
 copperleaf, Virginia  
 croton, Texas  
 croton, woolly  
 flixweed  
 galinsoga  
 geranium, Carolina  
 hemp, wild  
 horseweed (maretail)  
 jewelweed  
 jimsonweed  
 knotweed<sup>1</sup>  
 kochia  
 lambsquarters, common  
 lettuce, prickly<sup>1</sup>  
 lettuce, wild  
 lupines  
 mallow, little<sup>1</sup>  
 mallow, Venice<sup>1</sup>  
 marshelder  
 morningglory, annual  
 morningglory, ivy  
 morningglory, woolly  
 mousetail  
 mustards (except blue mustard)  
 parsnip, wild  
 pennycress, field  
 pepperweed<sup>1</sup>  
 pigweeds (*Amaranthus* spp.)<sup>1</sup>  
 poorjoe  
 primrose, common  
 purslane, common  
 pusley, Florida  
 radish, wild  
 ragweed, common  
 ragweed, giant  
 rape, wild  
 rocket, yellow  
 salsify, common<sup>1</sup>  
 salsify, western<sup>1</sup>  
 shepherdspurse  
 sicklepod  
 smartweed (annual species)<sup>1</sup>  
 sneezeweed, bitter  
 sowthistle, annual  
 sowthistle, spiny  
 spanishneedles  
 sunflower  
 sweetclover  
 tansymustard  
 thistle, bull  
 thistle, musk<sup>1</sup>  
 thistle, Russian (tumbleweed)<sup>1</sup>  
 velvetleaf  
 vetches

### Perennial Weeds

alfalfa<sup>1</sup>  
 artichoke, Jerusalem<sup>1</sup>  
 aster, many-flower<sup>1</sup>  
 Austrian fieldcress<sup>1</sup>  
 bindweed (hedge, field and European)<sup>1</sup>  
 blue lettuce  
 blueweed, Texas  
 broomweed  
 bullnettle<sup>1</sup>  
 carrot, wild<sup>1</sup>  
 catnip  
 chicory  
 clover, red<sup>1</sup>  
 coffeeweed  
 cress, hoary<sup>1</sup>  
 dandelion<sup>1</sup>  
 docks<sup>1</sup>  
 dogbanes<sup>1</sup>  
 eveningprimrose, cutleaf  
 garlic, wild<sup>1</sup>  
 goldenrod  
 hawkweed, orange<sup>1</sup>  
 healal  
 ironweed, western  
 ivy, ground<sup>1</sup>  
 Jerusalem artichoke  
 loco, bigbend  
 nettles (including stinging)<sup>1</sup>  
 onion, wild<sup>1</sup>  
 pennywort  
 plantains  
 ragwort, tansy<sup>1</sup>  
 sowthistle, perennial  
 thistle, Canada<sup>1</sup>  
 vervains<sup>1</sup>  
 waterplantain  
 wormwood

<sup>1</sup>These weeds are only partially controlled and may require repeat applications and/or use of higher specified rates of this product even under ideal conditions of application.

### Specific Use Directions

#### Forestry and Non-Cropland Areas

**Agricultural Use Requirements for Forest Use (Except Tree Injection Use):** For use in forests, follow PPE and re-entry instructions in the Agricultural Use Requirements section under the Directions for Use heading of this label.

**Agricultural Use Requirements for Forest (Tree Injection Only) and Non-Cropland Areas:** When this product is applied to non-cropland areas, and when applied by tree injection in forest sites, follow re-entry requirements given in the Non-Agricultural Use Requirements section under the Directions for Use heading of this label.

### Forestry Uses

Forest site preparation, forest roadsides, brush control, established conifer release (including Christmas trees and reforestation areas)

Treatment Site/ Method of Application	DMA 4 IVM	Specific Use Directions
annual weeds	2 - 4 pt/acre	Apply when weeds are small and growing actively before the bud stage. Apply when biennial and perennial species are in the seedling to rosette stage and before flower stalks appear. For difficult to control perennial broadleaf weeds and woody species, use up to 1 gallon of DMA 4 IVM and 1 to 4 quarts of Garlon® 3A herbicide per acre. For conifer release, make application in early spring before budbreak of conifers when weeds are small and actively growing.
biennial and perennial broadleaf weeds and susceptible woody plants	4 - 8 pt/acre	
spot treatment to control broadleaf weeds	1.28 fl oz/gal of spray solution (see instructions for Spot Treatment)	<b>Note:</b> To control broadleaf weeds in small areas with a hand sprayer, use an application rate equivalent to the specified broadcast rate and spray to thoroughly wet all foliage. Mix 1.28 fl oz per gallon of spray solution and apply through pump up sprayer or backpack sprayer. Addition of a non ionic surfactant is recommended to improve coverage. See rate conversion table and instructions for Spot Treatment and use of hand-held sprayers under Application.
conifer release: species such as white pine, ponderosa pine, jack pine, red pine, black spruce, white spruce, red spruce, and balsam fir	1 1/2 - 3 qt/acre	To control competing hardwood species such as alder, aspen, birch, hazel, and willow, apply from mid to late summer when growth of conifer trees has hardened off and woody plants are still actively growing. Apply with ground or air equipment, using sufficient spray volume to ensure complete coverage. Because this treatment may cause occasional conifer injury, do not apply if such injury cannot be tolerated.
directed spray: Conifer plantations including pine	4 qt/100 gal	Apply when brush or weeds are actively growing by directing the spray so as to avoid contact with conifer foliage and injurious amounts of spray. Apply in oil, oil-water, or water carrier in a spray volume of 10 to 100 gallons per acre.
basal spray (may also be used in rangeland, pastures, and noncropland)	8 qt/100 gal or	Thoroughly wet the base and root collar of all stems until the spray begins to accumulate around the root collar at the ground line. Wetting stems with the mixture may also aid in control.
surface of cut stumps (may also be used in rangeland, pastures, and noncropland)	2.5 fl oz/gal of water	Apply as soon as possible after cutting trees. Thoroughly soak the entire stump with the 2,4-D mixture including cut surface, bark and exposed roots.
frill and girdle (may also be used in rangeland, pastures, and noncropland)		Cut frills (overlapping V-shaped notches cut downward through the bark in a continuous ring around the base of the tree) using an axe or other suitable tool. Treat freshly cut frills with as much of the 2,4-D mixture as they will hold.

## Forestry Uses

Forest site preparation, forest roadsides, brush control, established conifer release (including Christmas trees and reforestation areas) (Cont.)

Treatment Site/ Method of Application	DMA 4 IVM	Specific Use Directions
tree injection application (may also be used in rangeland, pastures, and noncropland)	(1 - 2 ml per injection site)	To control unwanted hardwood trees such as elm, hickory, oak, and sweetgum in forests and other non-crop areas, apply by injecting at a rate of 1 ml of undiluted DMA 4 IVM per inch of trunk diameter at breast height (DBH) as measured approximately 4 1/2 ft above the ground. However, injection should occur as close to the root collar as possible and the injection bit must penetrate the inner bark. Applications may be made throughout the year, but for best results apply between May 15 and October 15. Maples should not be treated during the spring sap flow. For hard to control species such as ash, maple, and dogwood use 2 ml of undiluted DMA 4 IVM per injection site or double the number of 1 ml injections. <b>Note: No Worker Protection Standard worker entry restrictions or worker notification requirements apply when this product is directly injected into agricultural plants.</b>

### Precautions and Restrictions:

- Do not allow sprays to contact conifer shoot growth (current year's new growth) or injury may occur.
- Do not apply to nursery seed beds.
- For conifer release, do not use on plantations where pine or larch are among the desired species.
- For broadcast applications, do not apply more than 8.42 pints of DMA 4 IVM (4 lb of acid equivalent) per acre per 12-month period.
- Limited to 1 broadcast application per year
- For basal spray, cut surface stumps, and frill applications, do not apply more than 16.84 pints of DMA 4 IVM (8 lb of acid equivalent) per 100 gallons of spray solution.

### Non-Cropland Areas

Such as fencerows, hedgerows, roadsides, drainage ditches, rights-of way, utility power lines, railroads, airports, and other non-crop areas

Treatment Site/ Method of Application	DMA 4 IVM (pint/acre)	Specific Use Directions
annual broadleaf weeds	2 - 4	Apply when annual weeds are small and growing actively before the bud stage. Biennial and perennial weeds should be rosette to bud stage, but not flowering at the time of application. For difficult to control perennial broadleaf weeds and woody species, tank mix up to 1 gallon of DMA 4 IVM plus 1 to 4 quarts of Garlon 3A per acre. <b>For ground application:</b> (High volume) apply a total of 100 to 400 gallons per acre; (low volume) apply a total of 10 to 100 gallons per acre. <b>For helicopter:</b> Apply a total of 5 to 30 gallons per acre spray volume.
biennial and perennial broadleaf weeds	4	
susceptible woody plants on rights-of-way	4 - 8	
spot treatment to control broadleaf weeds	1.28 fl oz/gal of spray solution (see instructions for Spot Treatment)	<b>Note:</b> To control broadleaf weeds in small areas with a hand sprayer, use an application rate equivalent to the broadcast rate specified for this treatment site and spray to thoroughly wet all foliage. Mix 1.28 fl oz per gallon of spray solution and apply through pump up sprayer or backpack sprayer. Addition of a non ionic surfactant is recommended to improve coverage. See rate conversion table and instructions for Spot Treatment and use of hand-held sprayers under Application.
tree injection application		See instructions for tree injection application in Forestry Uses section.
southern wild rose broadcast application	up to 4	Broadcast: Apply in a spray volume of 5 gallons or more per acre by aircraft or 10 gallons or more per acre by ground equipment.
spot treatment	1.28 fl oz/gal of spray solution	Apply when foliage is well developed. Thorough coverage is required. Mix 1.28 fl oz per gallon of spray solution and apply through pump up sprayer or backpack sprayer. Addition of a non ionic surfactant is recommended to improve coverage. Two or more treatments may be required.

### Precautions and Restrictions:

- Do not apply to newly seeded areas until grass is well established.
- Bentgrass, St. Augustine, clover, legumes and dichondra may be severely injured or killed by this treatment.
- **Annual and perennial weeds:** Do not apply more than 4.21 pints of DMA 4 IVM (2 lb of acid equivalent) per acre per application. Do not make more than two applications per season. Do not reapply to a treated area within 30 days of a previous application.
- **Woody plants:** Do not apply more than 8.42 pints of DMA 4 IVM (4 lb of acid equivalent) per acre per use season. Do not make more than one application per season.
- Applications to non-cropland areas are not applicable to treatment of commercial timber or other plants being grown for sale or other commercial uses, or for commercial seed production, or for research purposes.

## Turfgrass Uses

### Ornamental Turfgrass (Excluding Grasses Grown for Seed or Sod Farms)

(Includes cemeteries and parks, airfields, roadsides, vacant lots, drainage ditch banks)

**Use Requirements for Ornamental Turfgrass Areas:** When this product is applied to ornamental turfgrass areas, follow PPE and reentry instructions in the Non-Agricultural Use Requirements section of this label.

Treatment Site/ Application Timing	DMA 4 IVM (pint/acre)	Specific Use Directions
ornamental turfgrass (postemergence) seedling grass (five-leaf stage or later)	3/4 - 1	Apply when weeds are small and actively growing. For best results, apply when soil moisture is adequate for active weed growth. Deep-rooted perennial weeds such as bindweed and Canada thistle may require repeat applications. Do not apply to newly seeded grasses until well established (five-leaf stage or later) and then use a maximum of 1 pint per acre. Cool season grasses are tolerant of higher rates.
well-established grasses	2 - 3	
biennial and perennial broadleaf weeds	3	

**Precautions and Restrictions:**

- Do not use on creeping grasses such as bent except as a spot treatment.
- Do not use on injury-sensitive southern grasses such as St. Augustinegrass.
- Do not use on dichondra or other herbaceous ground covers. Legumes may be damaged or killed.
- Do not reapply within 21 days of a previous application.
- **Reseeding:** Delay reseeding at least 30 days following application. Preferably, with spring application, reseed in the fall and with fall application, reseed in the spring.
- Do not apply more than 2 broadcast applications per year per treatment site (does not include spot treatments).
- Do not apply more than 6.32 pints per acre of DMA 4 IVM (3 lb of acid equivalent) per year.

**Aquatic Uses**

**Use Requirements for Aquatic Areas:** When this product is applied to aquatic areas, follow PPE and re-entry instructions in the Non-Agricultural Use Requirements section of this label.

**Control of Weeds and Brush on Banks of Irrigation Canals and Ditches**

Target Plants	DMA 4 IVM (pint/acre)	Specific Use Directions
annual weeds	2 to 4	Apply using low pressure spray (10 to 40 psi) in a spray volume of 20 to 100 gallons per acre using power operated spray equipment. Apply when wind speed is low, 5 mph or less. Apply working upstream to avoid accidental concentration of spray into water. Cross-stream spraying to opposite banks is not permitted and avoid boom spraying over water surface. When spraying shoreline weeds, allow no more than a 2-foot overspray onto water surface with an average of less than 1 foot of overspray to prevent significant water contamination.  Apply when weeds are small and growing actively before the bud stage. Apply when biennial and perennial species are in the seedling to rosette stage and before flower stalks appear. For hard to control weeds, a repeat application after 30 days at the same rate may be needed.  For woody species and patches of perennial weeds, mix 1 gallon of DMA 4 IVM per 64 to 150 gallons of total spray. Wet foliage by applying about 3 to 4 gallons of spray per 1000 sq ft (10.5 X 10.5 steps).
biennial and perennial broadleaf weeds and susceptible wood plants	4	

**Restrictions and Limitations:**

- Do not apply more than 2 treatments per season or reapply within 30 days.
- Use 2 gallons or more of spray solution per acre.
- Do not apply more than 4.21 pints (2 lb of acid equivalent) per acre per application or more than 8.42 pints (4 lb of acid equivalent) per acre per use season.

Do not use on small canals with a flow rate less than 10 cubic feet per second (CFS) where water will be used for drinking purposes. CFS may be estimated by using the formula below. The approximate velocity needed for the calculation can be determined by observing the length of time that it takes a floating object to travel a defined distance. Divide the distance (ft) by the time (sec) to estimate velocity (ft per sec). Repeat 3 times and use the average to calculate CFS.

Average Width (ft) x Average Depth (ft) x Average Velocity (ft per sec) = CFS

**For ditchbank weeds:** Do not spray cross-stream to opposite bank. Do not allow boom spray to be directed onto water.

**For shoreline weeds:** Boom spraying onto water surface must be held to a minimum and allow no more than a 2-foot overspray onto water with an average of less than 1 foot overspray to prevent introduction of greater than negligible amounts of chemical into the water.

**Aquatic Weed Control in Ponds, Lakes, Reservoirs, Marshes, Bayous, Drainage Ditches, Canals, Rivers and Streams That are Quiescent or Slow Moving, Including Programs of the Tennessee Valley Authority**

**Notice to Applicators:** Before application, coordination and approval of local and state authorities may be required, either by letter or agreement or issuance of special permits for aquatic applications.

**Emergent and Floating Aquatic Weeds: Including Water hyacinth (*Eichhornia crassipes*)**

**Application Rate:** 2 to 4 quarts per acre.

**Specific Use Directions**

**Application Timing:** Spray weed mass only. Apply when water hyacinth plants are actively growing. Repeat application as necessary to kill regrowth and plants missed in previous operation. Use the 4 quart per acre rate when plants are mature or when weed mass is dense.

**Surface Application:** Use power operated sprayers with boom or spray gun mounted on boat, tractor or truck. Thorough wetting of foliage is essential for maximum control. Use 100 to 400 gallons of spray mixture per acre. Special precautions such as use of low pressure, large nozzles and spray thickening agents should be taken to avoid spray drift to susceptible crops. Follow label directions for use of any drift control agent.

**Aerial Application:** Use drift control spray equipment or thickening agent mixed in the spray mixture. Apply 1 gallon of DMA 4 IVM per acre using standard boom systems using a minimum spray volume of 5 gallons per acre. For Microfoil drift control spray systems, apply DMA 4 IVM in a total spray volume of 12 to 15 gallons per acre.

**Restrictions and Limitations for Surface Applications to Emergent Aquatic Weeds**

- Do not exceed 8.42 pints per acre (4 lb of acid equivalent) per surface acre per
- Spot treatments are permitted.
- Limited to two applications per season.
- Minimum of 21 days between applications.

Fish breathe dissolved oxygen in the water and decaying weeds also use oxygen. When treating continuous, dense weed masses, it may be appropriate to treat only part of the infestation at a time. For example, apply the product in lanes separated by untreated strips that can be treated after vegetation in treated lanes has disintegrated. During the growing season, weeds decompose in a 2 to 3 week period following

treatment. Waters having limited and less dense weed infestations may not require partial treatments. Other local factors such as water exchange and sediment load can also influence the dissolved oxygen level. Coordination and approval of local and state authorities may be required, either by letter of agreement or issuance of special permits for aquatic applications.

**Water Use:**

**1. Water for irrigation or sprays:**

- A. If treated water is intended to be used only for crops or non-crop areas that are labeled for direct treatment with 2,4-D such as pastures, turfgrass or cereal grains, the treated water may be used to irrigate and/or mix sprays for these sites at anytime after the 2,4-D aquatic application.
- B. Due to potential phytotoxicity considerations, the following restrictions are applicable: If treated water is intended to be used to irrigate or mix sprays for plants grown in commercial nurseries and greenhouses; and other plants or crops that are not labeled for direct treatment with 2,4-D, the water must not be used unless one of the following restrictions has been observed:
  - i. A setback distance from functional water intake(s) of  $\geq 600$  ft. was used for the application, or,
  - ii. A waiting period of 7 days from the time of application has elapsed, or,
  - iii. An approved assay indicates that the 2,4-D concentration is 100 ppb (0.1 ppm) or less at the water intake. Wait at least 3 days after application before initial sampling at water intake.

**2. Drinking water (potable water):**

- A. Consult with appropriate state or local water authorities before applying this product to public waters. State or local agencies may require permits. The potable water use restrictions on this label are to ensure that consumption of water by the public is allowed only when the concentration of 2,4-D in the water is less than the MCL (Maximum Contaminant Level) of 70 ppb. Applicators should consider the unique characteristics of the treated waters to assure that 2,4-D concentrations in potable water do not exceed 70 ppb at the time of consumption.
- B. For floating and emergent weed applications, the drinking water setback distance from functioning potable water intakes is  $\geq 600$  ft.
- C. If no setback distance of  $\geq 600$  ft. is used for the application, applicators or the authorizing organization must provide a drinking water notification prior to a 2,4-D application to the party responsible for a public water supply or to individual private water users. Notification to the party responsible for a public water supply or to individual private water users must be done in a manner to assure that the party is aware of a water use restrictions when this product is applied to potable water.

The following is an example of an example of notification via posting, but other methods of notification which convey the above restrictions may be used and may be required in some cases under state or local law or as a condition of a permit.

**Example:**

Posting notification should be located every 250 feet including the shoreline of the treated area and up to 250 feet of shoreline past the application site to include immediate public access points. Posting must include the day and time of application. Posting may be removed if analysis of a sample collected at the intake 3 days or more following application shows that the concentration in the water is less than 70 ppb (100 ppb for irrigation or sprays), or after 7 days following application, whichever occurs first.

**Text of notification:** Wait 7 days before diverting functioning surface water intakes from the treated aquatic site to use as drinking water, irrigation, or sprays, unless water at functioning drinking water intakes is tested at least 3 days after application and is demonstrated by assay to contain not more than 70 ppb 2,4-D (100 ppb for irrigation or sprays).  
Application Date: \_\_\_\_\_ Time: \_\_\_\_\_

- D. Following each application of this product, treated water must not be used for drinking water unless one of the following restrictions has been observed:
  - i. A setback distance from functional water intake(s) of  $\geq 600$  ft. was used for the application, or,
  - ii. A waiting period of at least 7 days from the time of application has elapsed, or,
  - iii. An approved assay indicates that the 2,4-D concentration is 70 ppb (0.07 ppm) or less at the water intake. Sampling for drinking water analysis should occur no sooner than 3 days after 2,4-D application. Analysis of samples must be completed by a laboratory that is certified under the Safe Drinking Water Act to perform drinking water analysis using a currently approved version of analytical Method Number 515, 555, other methods for 2,4-D as may be listed in Title 40 CFR Part 141.24, or Method Number 4015 (immunoassay of 2,4-D) from U.S. EPA Test Methods for Evaluating Solid Waste SW-846.
- E. Note: Existing potable water intakes that are no longer in use, such as those replaced by a connection to a municipal water system or a potable water well, are not considered to be functioning potable water intakes.
- F. Drinking water setback distances do not apply to terrestrial applications of 2,4-D adjacent to water bodies with potable water intakes.

**Submerged Aquatic Weeds: Including Eurasian Water Milfoil (*Myriophyllum spicatum*)**

Treatment Site	Maximum Application Rate <sup>1</sup>	Specific Use Directions
aquatic weed control in ponds, lakes, reservoirs, marshes, bayous, drainage ditches, canals, rivers and streams that are quiescent or slow moving, including programs of the Tennessee Valley Authority	2.84 gallons (10.8 lb of acid equivalent) per acre foot	<p><b>Application Timing:</b> For best results, apply in spring or early summer when aquatic weeds appear. Check for weed growth in areas heavily infested the previous year. A second application may be needed when weeds show signs of recovery, but no later than mid-August in most areas.</p> <p><b>Subsurface Application:</b> Apply DMA 4 IVM undiluted directly to the water through a boat mounted distribution system. Shoreline areas should be treated by subsurface injection application by boat to avoid aerial drift.</p> <p><b>Surface Application:</b> Use power operated boat mounted boom sprayer. If rate is less than 5 gallons per acre, dilute to a minimum spray volume of 5 gallons per surface acre.</p> <p><b>Aerial Application:</b> Use drift control spray equipment or thickening agents mixed with sprays to reduce drift. Apply through standard boom systems in a minimum spray volume of 5 gallons per surface acre. For Microfoil drift control spray systems, apply DMA 4 IVM in a total spray volume of 12 to 15 gallons per acre. Apply to attain a concentration of 2 to 4 ppm (see table below).</p>

<sup>1</sup>DMA 4 IVM contains 3.8 lb of acid equivalent per gallon of product.

**Table 1: Amount to Apply for a Target Subsurface Concentration**

Surface Area	Average Depth (ft)	For typical conditions - 2 ppm (2,4-D a.e./acre)	For typical conditions - 2 ppm (DMA 4 IVM gal/acre)	For difficult conditions - 4 ppm* (2,4-D a.e./acre)	For difficult conditions - 4 ppm* (DMA 4 IVM gal/acre)
1 acre	1	5.4	1.42	10.8	2.84
	2	10.8	2.84	21.6	5.68
	3	16.2	4.26	32.4	8.53
	4	21.6	5.68	43.2	11.37
	5	27.0	7.10	54.0	14.21

\*Examples include spot treatments of pioneer colonies of Eurasian water milfoil and certain difficult to control aquatic species.

**Restrictions and Limitations for Aquatic Sites With Submersed Weeds**

Do not exceed 10.8 lb acid equivalent per acre foot.

Fish breathe oxygen in the water and a water-oxygen ratio must be maintained. Decaying weeds use up oxygen, but during the period when applications should be made, the weed mass is fairly sparse and the weed decomposition rate is slow enough that the water-oxygen ratio is not disturbed by treating the entire area at one time. If treatments must be applied later in the season when the weed mass is dense and repeat treatments are needed, apply product in lanes, leaving buffer strips which can then be treated when vegetation in treated lanes has disintegrated. During the growing season, weeds decompose in a 2- to 3-week period following treatment.

Do not apply within 21 days of previous application. Limited to 2 applications per season.

When treating moving bodies of water, applications must be made while traveling upstream to prevent concentration of 2,4-D downstream from the application.

Coordination and approval of local and state authorities may be required, either by letter of agreement or issuance of special permits for such use.

**Water Use:**

**1. Water for irrigation or sprays:**

- A. If treated water is intended to be used only for crops or non-crop areas that are labeled for direct treatment with 2,4-D such as pastures, turfgrass or cereal grains, the treated water may be used to irrigate and/or mix sprays for these sites at anytime after the 2,4-D aquatic application.
- B. Due to potential phytotoxicity and/or residue considerations, the following restrictions are applicable:

If treated water is intended to be used to irrigate or mix sprays for unlabeled crops, non-crop areas or other plants not labeled for direct treatment with 2,4-D, the water must not be used unless one of the following restrictions has been observed:

- i) A setback distance described in the Drinking Water Setback Table was used for the application, or,
- ii) A waiting period of 21 days from the time of application has elapsed, or,
- iii) An approved assay indicates that the 2,4-D concentration is 100 ppb (0.1 ppm) or less at the water intake. See Table 3 for the waiting period after application but before taking the initial sampling at water intake.

**2. Drinking water (potable water):**

- A. Consult with appropriate state or local water authorities before applying this product to public waters. State or local agencies may require permits. The potable water use restrictions on this label are to ensure that consumption of water by the public is allowed only when the concentration of 2,4-D in the water is less than the MCL (Maximum Contaminant Level) of 70 ppb. Applicators should consider the unique characteristics of the treated waters to assure that 2,4-D concentrations in potable water do not exceed 70 ppb at the time of consumption.
- B. For submersed weed applications, the drinking water setback distances from functioning potable water intakes are provided in Table 2 Drinking Water Setback Distance (below).
- C. If no setback distance from the Drinking Water Setback Table (Table 2) is to be used for the application, applicators or the authorizing organization must provide a drinking water notification and an advisory to shut off all potable water intakes prior to a 2,4-D application. Notification to the party responsible for a public water supply or to individual private water users must be done in a manner to assure that the party is aware of the water use restrictions when this product is applied to potable water.

The following is an example of an example of notification via posting, but other methods of notification which convey the above restrictions may be used and may be required in some cases under state or local law or as a condition of a permit.

**Example:**

Posting notification should be located every 250 feet including the shoreline of the treated area and up to 250 feet of shoreline past the application site to include immediate public access points. Posting should include the day and time of application. Posting may be removed if analysis of a sample collected at the intake no sooner than stated in Table 3 (below) shows that the concentration in the water is less than 70 ppb (100 ppb for irrigation or sprays), or after 21 days following application, whichever occurs first.

**Text of notification:** Wait 21 days before diverting functioning surface water intakes from the treated aquatic site to use as drinking water, irrigation, or sprays, unless water at functioning drinking water intakes is tested no sooner than (insert days from Table 3) and is demonstrated by assay to contain not more than 70 ppb 2,4-D (100 ppb for irrigation or sprays).

Application Date: \_\_\_\_\_ Time: \_\_\_\_\_ .

- D. Following each application of this product, treated water must not be used for drinking water unless one of the following restrictions has been observed:
  - i) A setback distance described in the Drinking Water Setback Distance Table was used for the application, or,
  - ii) A waiting period of at least 21 days from the time of application has elapsed, or,
  - iii) An approved assay indicates that the 2,4-D concentration is 70 ppb (0.07 ppm) or less at the water intake. Sampling for drinking water analysis should occur no sooner than stated in Table 3. Analysis of samples must be completed by a laboratory that is certified under The Safe Drinking Water Act to perform drinking water analysis using a currently approved version of analytical Method Number 515, 555, other methods for 2,4-D as may be listed in Title 40 CFR, Part 141.24, or Method Number 4015 (immunoassay of 2,4-D) from U.S. EPA Test Methods for Evaluating Solid Waste SW-846.
- E. Note: Existing potable water intakes that are no longer in use, such as those replaced by a connection to a municipal water system or a potable water well, are not considered to be functioning potable water intakes.
- F. Drinking water setback distances do not apply to terrestrial applications of 2,4-D adjacent to water bodies with potable water intakes.

**Table 2: Drinking Water Setback Distance for Submersed Weed Applications**

Application Rate and Minimum Setback Distance (feet) From Functioning Potable Water Intake			
1 ppm*	2 ppm*	3 ppm*	4 ppm*
600	1200	1800	2400

\*ppm acid equivalent target water concentration

**Table 3: Sampling for Drinking Water Analysis After 2,4-D Application for Submersed Weed Applications**

Minimum Days After Application Before Initial Water Sampling at the Functioning Potable Water Intake			
1 ppm*	2 ppm*	3 ppm*	4 ppm*
5	10	10	14

\*ppm acid equivalent target water concentration

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### Terms and Conditions of Use

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If terms of the following Warranty Disclaimer, Inherent Risks of Use and Limitation of Remedies are not acceptable, return unopened package at once to the seller for a full refund of purchase price paid. To the extent permitted by law, otherwise, use by the buyer or any other user constitutes acceptance of the terms under Warranty Disclaimer, Inherent Risks of Use and Limitation of Remedies.

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### Warranty Disclaimer

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Dow AgroSciences warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. TO THE EXTENT PERMITTED BY LAW, Dow AgroSciences MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.

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### Inherent Risks of Use

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It is impossible to eliminate all risks associated with use of this product. Crop injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label, such as unfavorable temperatures, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner of application, or other factors, all of which are beyond the control of Dow AgroSciences or the seller. To the extent permitted by law, all such risks shall be assumed by buyer.

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### Limitation of Remedies

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To the extent permitted by law, the exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability, or other legal theories), shall be limited to, at Dow AgroSciences' election, one of the following:

1. Refund of purchase price paid by buyer or user for product bought, or
2. Replacement of amount of product used.

To the extent permitted by law, Dow AgroSciences shall not be liable for losses or damages resulting from handling or use of this product unless Dow AgroSciences is promptly notified of such loss or damage in writing. To the extent permitted by law, in no case shall Dow AgroSciences be liable for consequential or incidental damages or losses.

The terms of the Warranty Disclaimer, Inherent Risks of Use and Limitation of Remedies cannot be varied by any written or verbal statements or agreements. No employee or sales agent of Dow AgroSciences or the seller is authorized to vary or exceed the terms of the Warranty Disclaimer or Limitation of Remedies in any manner.

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**Produced for  
Dow AgroSciences LLC  
9330 Zionsville Road  
Indianapolis, IN 46268**

Label Code: D02-141-004  
Replaces Label: D02-141-003  
LOES Number: 010-00108

EPA accepted 06/14/10

### Revisions:

1. Goggles or faceshield changed to protective eyewear.

# Specimen Label



# Garlon<sup>®</sup> 3A

## Specialty Herbicide

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**For the control of woody plants, broadleaf weeds in forests and industrial non-crop areas, including manufacturing and storage sites, rights-of-way such as electrical power lines, communication lines, pipelines, roadsides, railroads, fence rows, non-irrigation ditch banks, and around farm buildings; including application to grazed areas, and establishment and maintenance of wildlife openings on these sites, and in Christmas tree plantations. Use within production forests and industrial non-crop sites (including those listed above) may include applications to control target vegetation in and around standing water sites, such as marshes, wetlands, and the banks of ponds and lakes.**

For use in New York State, comply with Section 24(c) Special Local Need labeling for Garlon 3A, SLN NY-060002.

Active Ingredient:	
triclopyr: 3,5,6-trichloro-2-pyridinyloxyacetic acid, triethylamine salt.....	44.4%
Other Ingredients.....	55.6%
Total .....	100.0%

Acid equivalent: triclopyr - 31.8% - 3 lb/gal

EPA Reg. No. 62719-37

**Keep Out of Reach of Children**

# DANGER PELIGRO

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

## Precautionary Statements

### Hazard to Humans and Domestic Animals

**Corrosive • Causes Irreversible Eye Damage • Harmful If Swallowed Or Absorbed Through Skin • Prolonged Or Frequently Repeated Skin Contact May Cause Allergic Reaction In Some Individuals**

Do not get in eyes or on skin or clothing.

### Personal Protective Equipment (PPE)

**Applicators and other handlers must wear:**

- Long-sleeved shirt and long pants
- Shoes plus socks
- Protective eyewear
- Chemical resistant gloves (≥14 mils) such as butyl rubber, natural rubber, neoprene rubber or nitrile rubber

Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them. Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

### Engineering Controls

When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the WPS (40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the WPS.

### User Safety Recommendations

Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

### First Aid

**If in eyes:** Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

**If on skin or clothing:** Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.

**If swallowed:** Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by a poison control center or doctor. Do not give anything by mouth to an unconscious person. Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-992-5994 for emergency medical treatment information.

**Note to Applicator:** Allergic skin reaction is not expected from exposure to spray mixtures of Garlon 3A herbicide when used as directed.

**Note to Physician:** Probable mucosal damage may contraindicate the use of gastric lavage.

## Environmental Hazards

Do not contaminate water when cleaning equipment or disposing of equipment washwaters. Under certain conditions, treatment of aquatic weeds can result in oxygen depletion or loss due to decomposition of dead plants, which may contribute to fish suffocation. This loss can cause fish suffocation. Therefore, to minimize this hazard, do not treat more than one-third to one-half of the water area in a single operation and wait at least 10 to 14 days between treatments. Begin treatment along the shore and proceed outwards in bands to allow fish to move into untreated areas. Consult with the State agency for fish and game before applying to public water to determine if a permit is needed.

This chemical has properties and characteristics associated with chemicals detected in groundwater. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination.

## Physical or Chemical Hazards

**Combustible.** Do not use or store the product near heat or open flame.

**Notice:** Read the entire label. Use only according to label directions. **Before using this product, read Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies elsewhere on this label. If terms are unacceptable, return at once unopened.**

In case of emergency endangering health or the environment involving this product, call 1-800-992-5994. If you wish to obtain additional product information, visit our web site at [www.dowagro.com](http://www.dowagro.com).

Agricultural Chemical: Do not ship or store with food, feeds, drugs or clothing.

## Directions for Use

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Read all Directions for Use carefully before applying.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your state or tribe, consult the agency responsible for pesticide regulation

## Agricultural Use Requirements

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR Part 170. This Standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE), and restricted-entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 48 hours.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water, is:

- Coveralls
- Shoes plus socks
- Protective eyewear
- Chemical-resistant gloves ( $\geq 14$  mils) such as butyl rubber, natural rubber, neoprene rubber or nitrile rubber

## Non-Agricultural Use Requirements

The requirements in this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard for Agricultural Pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries, or greenhouses.

**Entry Restrictions for Non-WPS Uses:** For applications to non-cropland areas, do not allow entry into areas until sprays have dried, unless applicator and other handler PPE is worn.

## Storage and Disposal

Do not contaminate water, food, or feed by storage and disposal. Open dumping is prohibited.

**Pesticide Storage:** Store above 28°F or agitate before use.

**Pesticide Disposal:** Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

### Nonrefillable containers 5 gallons or less:

**Container Reuse:** Nonrefillable container. Do not reuse or refill this container. Offer for recycling if available.

Triple rinse or pressure rinse container (or equivalent) promptly after emptying. **Triple rinse** as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container 1/4 full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. **Pressure rinse** as follows: Empty the remaining contents into application equipment or a mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 psi for at least 30 seconds. Drain for 10 seconds after the flow begins to drip.

### Refillable containers 5 gallons or larger:

**Container Reuse:** Refillable container. Refill this container with pesticide only. Do not reuse this container for any other purpose. Cleaning the container before final disposal is the responsibility of the person disposing of the container. Cleaning before refilling is the responsibility of the refiller. To clean the container before final disposal, empty the remaining contents from this container into application equipment or a mix tank. Fill the container about 10% full with water and, if possible, spray all sides while adding water. If practical, agitate vigorously or recirculate water with the pump for two minutes. Pour or pump rinsate into application equipment or rinsate collection system. Repeat this rinsing procedure two more times.

### Nonrefillable containers 5 gallons or larger:

**Container Reuse:** Nonrefillable container. Do not reuse or refill this container. Offer for recycling if available.

Triple rinse or pressure rinse container (or equivalent) promptly after emptying. **Triple rinse** as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two more times. **Pressure rinse** as follows: Empty the remaining contents into application equipment or a mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 psi for at least 30 seconds. Drain for 10 seconds after the flow begins to drip.

## General Information for Production Forests and Industrial Non-Crop Areas

Use Garlon® 3A specialty herbicide for the control of woody plants and broadleaf weeds in forests and industrial non-crop areas including manufacturing and storage sites, rights-of-way such as electrical power lines, communication lines, pipelines, roadsides, railroads, fence rows, non-irrigation ditch banks, and around farm buildings, including application to grazed areas, and establishment and maintenance of wildlife openings on these sites, and in Christmas tree plantations. Use within production forests and industrial non-crop sites (including those listed above) may include applications to control target vegetation in and around standing water sites, such as marshes, wetlands, and the banks of ponds and lakes.

**Obtain Required Permits:** Consult with appropriate state or local water authorities before applying this product to public waters. State or local public agencies may require permits.

## General Use Precautions and Restrictions

For use in New York State, comply with Section 24(c) Special Local Need labeling for Garlon 3A, SLN NY-060002.

When applying this product in tank mix combination, follow all applicable use directions, precautions and limitations on each manufacturer's label.

**Chemigation:** Do not apply this product through any type of irrigation system.

Do not apply Garlon 3A directly to, or otherwise permit it to come into direct contact with, grapes, tobacco, vegetable crops, flowers, or other desirable broadleaf plants. Do not permit spray mists containing Garlon 3A to drift onto such plants.

It is permissible to treat non-irrigation ditch banks, seasonally dry wetlands (such as flood plains, deltas, marshes, swamps, or bogs) and transitional areas between upland and lowland sites.

Water treated with Garlon 3A may not be used for irrigation purposes for 120 days after application or until residue levels of Garlon 3A are determined by laboratory analysis, or other appropriate means of analysis, to be 1 ppb or less.

**Seasonal Irrigation Waters:** Garlon 3A may be applied during the off-season to surface waters that are used for irrigation on a seasonable basis provided that there is a minimum of 120 days between applying Garlon 3A and the first use of treated water for irrigation purposes, or until residue levels of Garlon 3A are determined by laboratory analysis, or other appropriate means of analysis, to be 1 ppb or less.

**Irrigation Canals/Ditches:** Do not apply Garlon 3A to irrigation canals/ditches unless the 120-day restriction on irrigation water usage can be observed or residue levels of Garlon 3A are determined by laboratory analysis, or other appropriate means of analysis, to be 1 ppb or less.

- Do not apply to salt water bays or estuaries.
- Do not apply directly to un-impounded rivers or streams.
- Do not apply on ditches or canals currently being used to transport irrigation water or that will be used for irrigation within 4 months following treatment. It is permissible to treat irrigation and non-irrigation ditch banks.
- Do not apply where runoff water may flow onto agricultural land as injury to crops may result.
- When making applications to control unwanted plants on banks or shorelines of moving water sites, minimize overspray to open water.

- The use of a mistblower is not recommended.
- Apply no more than 2 lb ae of triclopyr (2/3 gallon of Garlon 3A) per acre per growing season on range and pasture sites, including rights-of-way, fence rows or any area where grazing or harvesting is allowed.
- On forestry sites, Garlon 3A may be used at rates up to 6 lb ae of triclopyr (2 gallons of Garlon 3A) per acre per year.
- For all terrestrial use sites other than range, pasture, forestry sites, and grazed areas, the maximum application rate is 9 lb ae of triclopyr (3 gallons of Garlon 3A) per acre per year.

## Precautions for Potable Water Intakes for Emerged Aquatic Weed Control

See chart below for specific setback distances near functioning potable water intakes. **Note:** Existing potable water intakes which are no longer in use, such as those replaced by potable water wells or connections to a municipal water system, are not considered to be functioning potable water intakes. These setback restrictions do not apply to terrestrial applications made adjacent to potable water intakes.

Area Treated (acres)	Garlon 3A Application Rate			
	2 qt/acre	4 qt/acre	6 qt/acre	8 qt/acre
4	0	200	400	500
>4 - 8	0	200	700	900
>8 - 16	0	200	700	1000
>16	0	200	900	1300

To apply Garlon 3A around and within the distances noted above from a functioning potable water intake, the intake must be turned off until the triclopyr level in the intake water is determined to be 0.4 parts per million (ppm) or less by laboratory analysis or immunoassay.

- **Recreational Use of Water in Treatment Area:** There are no restrictions on use of water in the treatment area for recreational purposes, including swimming and fishing.
- **Livestock Use of Water from Treatment Area:** There are no restrictions on livestock consumption of water from the treatment area.

## Grazing and Haying Restrictions

Except for lactating dairy animals, there are no grazing restrictions following application of this product.

- **Grazing Lactating Dairy Animals:** Do not allow lactating dairy animals to graze treated areas until the next growing season following application of this product.
- Do not harvest hay for 14 days after application.
- Grazed areas of non-cropland and forestry sites may be spot treated if they comprise no more than 10% of the total grazable area.

**Slaughter Restrictions:** During the season of application, withdraw livestock from grazing treated grass at least 3 days before slaughter.

## Avoiding Injurious Spray Drift

Make applications only when there is little or no hazard from spray drift. Small quantities of spray, which may not be visible, may seriously injure susceptible plants. Do not spray when wind is blowing toward susceptible crops or ornamental plants that are near enough to be injured. It is suggested that a continuous smoke column at or near the spray site or a smoke generator on the spray equipment be used to detect air movement, lapse conditions, or temperature inversions (stable air). If the smoke layers or indicates a potential of hazardous spray drift, do not spray.

**Aerial Application:** For aerial application on rights-of-way or other areas near susceptible crops, apply through a Microfoil<sup>†</sup> or Thru-Valve boom<sup>†</sup>, or use an agriculturally labeled drift control additive. Other drift reducing systems or thickened sprays prepared by using high viscosity inverting systems may be used if they are made as drift-free as mixtures containing agriculturally labeled thickening agents or applications made with the Microfoil or Thru-Valve boom. Keep spray pressures low enough to provide coarse spray droplets. Spray boom should be no longer than 3/4 of the rotor length. Do not use a thickening agent with the Microfoil or Thru-Valve booms, or other systems that cannot accommodate thick sprays. Spray only when the wind velocity is low (follow state regulations). Avoid application during air inversions. If a spray thickening agent is used, follow all use recommendations and precautions on the product label.

<sup>†</sup> Reference within this label to a particular piece of equipment produced by or available from other parties is provided without consideration for use by the reader at its discretion and subject to the reader's independent circumstances, evaluation, and expertise. Such reference by Dow AgroSciences is not intended as an endorsement of such equipment, shall not constitute a warranty (express or implied) of such equipment, and is not intended to imply that other equipment is not available and equally suitable. Any discussion of methods of use of such equipment does not imply that the reader should use the equipment other than is advised in directions available from the equipment's manufacturer. The reader is responsible for exercising its own judgment and expertise, or consulting with sources other than Dow AgroSciences, in selecting and determining how to use its equipment.

### Spray Drift Management

Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment and weather related factors determine the potential for spray drift. The applicator and the grower are responsible for considering all these factors when making decisions.

The following drift management requirements must be followed to avoid off-target drift movement from aerial applications:

1. The distance of the outer most operating nozzles on the boom must not exceed 3/4 the length of the rotor.
2. Nozzles must always point backward parallel with the air stream and never be pointed downwards more than 45 degrees.

Where states have more stringent regulations, they should be observed.

The applicator should be familiar with and take into account the information covered in the following Aerial Drift Reduction Advisory. [This information is advisory in nature and does not supersede mandatory label requirements.]

### Aerial Drift Reduction Advisory

**Information on Droplet Size:** The most effective way to reduce drift potential is to apply large droplets. The best drift management strategy is to apply the largest droplets that provide sufficient coverage and control. Applying larger droplets reduces drift potential, but will not prevent drift if applications are made improperly, or under unfavorable environmental conditions (see Wind, Temperature and Humidity, and Temperature Inversions).

### Controlling Droplet Size:

- **Volume** - Use high flow rate nozzles to apply the highest practical spray volume. Nozzles with higher rated flows produce larger droplets.
- **Pressure** - Do not exceed the nozzle manufacturer's recommended pressures. For many nozzle types, lower pressure produces larger droplets. When higher flow rates are needed, use higher flow rate nozzles instead of increasing pressure.
- **Number of Nozzles** - Use the minimum number of nozzles that provide uniform coverage.
- **Nozzle Orientation** - Orienting nozzles so that the spray is released parallel to the airstream produces larger droplets than other orientations and is the recommended practice. Significant deflection from horizontal will reduce droplet size and increase drift potential.
- **Nozzle Type** - Use a nozzle type that is designed for the intended application. With most nozzle types, narrower spray angles produce larger droplets. Consider using low-drift nozzles. Solid stream nozzles oriented straight back produce the largest droplets and the lowest drift.

**Boom Length:** For some use patterns, reducing the effective boom length to less than 3/4 of the rotor length may further reduce drift without reducing swath width.

**Application Height:** Applications should not be made at a height greater than 10 feet above the top of the largest plants unless a greater height is required for aircraft safety. Making applications at the lowest height that is safe reduces exposure of droplets to evaporation and wind.

**Swath Adjustment:** When applications are made with a crosswind, the swath will be displaced downwind. Therefore, on the up and downwind edges of the field, the applicator must compensate for this displacement by adjusting the path of the aircraft upwind. Swath adjustment distance should increase, with increasing drift potential (higher wind, smaller drops, etc.).

**Wind:** Drift potential is lowest between wind speeds of 2 to 10 mph. However, many factors, including droplet size and equipment type, determine drift potential at any given speed. Application should be avoided below 2 mph due to variable wind direction and high inversion potential. **Note:** Local terrain can influence wind patterns. Every applicator should be familiar with local wind patterns and how they affect spray drift.

**Temperature and Humidity:** When making applications in low relative humidity, set up equipment to produce larger droplets to compensate for evaporation. Droplet evaporation is most severe when conditions are both hot and dry.

**Temperature Inversions:** Applications should not occur during a local, low level temperature inversion because drift potential is high. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain in a concentrated cloud. This cloud can move in unpredictable directions due to the light variable winds common during inversions. Temperature inversions are characterized by increasing temperatures with altitude and are common on nights with limited cloud cover and light to no wind. They begin to form as the sun sets and often continue into the morning. Their presence can be indicated by ground fog; however, if fog is not present, inversions can also be identified by the movement of the smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally in a concentrated cloud (under low wind conditions) indicates an inversion, while smoke that moves upward and rapidly dissipates indicates good vertical air mixing.

**Sensitive Areas:** The pesticide should only be applied when the potential for drift to adjacent sensitive areas (e.g., residential areas, bodies of water, known habitat for threatened or endangered species, non-target crops) is minimal (e.g., when wind is blowing away from the sensitive areas).

**Ground Equipment:** To aid in reducing spray drift, Garlon 3A should be used in thickened (high viscosity) spray mixtures using an agriculturally labeled drift control additive, high viscosity invert system, or equivalent as directed by the manufacturer. With ground equipment, spray drift can be reduced by keeping the spray boom as low as possible; by applying 20 gallons or more of spray per acre; by keeping the operating spray pressures at the lower end of the manufacturer's recommended pressures for the specific nozzle type used (low pressure nozzles are available from spray equipment manufacturers); and by spraying when wind velocity is low (follow state regulations). In hand-gun applications, select the minimum spray pressure that will provide adequate plant coverage (without forming a mist). Do not apply with nozzles that produce a fine-droplet spray.

**High Volume Leaf-Stem Treatment:** To minimize spray drift, do not use pressure exceeding 50 psi at the spray nozzle and keep sprays no higher than brush tops. An agriculturally labeled thickening agent may be used to reduce drift.

## Plants Controlled

### Woody Plant Species

alder	dogwood	salt cedar <sup>2n</sup>
arrowwood	elderberry	salmonberry
ash	elm	sassafras
aspen	gallberry	scotch broom
Australian pine	hazel	sumac
bear clover (bearmat)	hornbeam	sweetbay magnolia
beech	kudzu <sup>1</sup>	sweetgum
birch	locust	sycamore
blackberry	madrone	tanoak
blackgum	maples	thimbleberry
Brazilian pepper	mulberry	tulip poplar
casara	oaks	waxmyrtle
ceanothus	persimmon	western hemlock
cherry	pine	wild rose
chinquapin	poison ivy	willow
choke cherry	poison oak	winged elm
cottonwood	poplar	
crataegus (hawthorn)	salt-bush	
Douglas fir	( <i>Baccharis</i> spp.)	

<sup>1</sup>For complete control, re-treatment may be necessary.

<sup>2</sup>Use cut surface treatments for best results.

### Annual and Perennial Broadleaf Weeds

bindweed	Mexican petunia	tropical soda apple
burdock	plantain	vetch
Canada thistle	purple loosestrife	wedelia
chicory	ragweed	wild lettuce
curly dock	smartweed	
dandelion	Spanish needles/	
field bindweed	common beggarthicks	
lambquarter	tansy ragwort	

## Purple Loosestrife (*Lythrum salicaria*)

Purple loosestrife can be controlled with foliar applications of Garlon 3A. For broadcast applications, use a minimum of 4 1/2 to 6 lb ae of triclopyr (6 to 8 quarts of Garlon 3A) per acre. Apply Garlon 3A when purple loosestrife is at the bud to mid-flowering stage of growth. Follow-up applications for control of regrowth should be made the following year in order to achieve increased control of this weed species. For all applications, a non-ionic surfactant should be added to the spray mixture. Follow all directions and use precautions on the label of the surfactant. Thorough wetting of the foliage and stems is necessary to achieve satisfactory control. A minimum spray volume of 50 gallons per acre is recommended for ground broadcast applications.

If using a backpack sprayer, a spray mixture containing 1% to 1.5% Garlon 3A or 5 to 7.6 fl oz of Garlon 3A per 4 gallons of water should be used. All purple loosestrife plants should be thoroughly wetted.

## Application Methods

Use Garlon 3A at rates of 3/4 to 9 lb ae of triclopyr (1/4 to 3 gallons of Garlon 3A) per acre to control broadleaf weeds and woody plants. In all cases, use the amount specified in enough water to give uniform and complete coverage of the plants to be controlled. Use only water suitable for spraying. Use an agriculturally labeled non-ionic surfactant for all foliar applications. When using surfactants, follow the use directions and precautions listed on the surfactant manufacturer's label. Use the higher concentrations of surfactant in the spray mixture when applying lower spray volumes per acre. The order of addition to the spray tank is water, spray thickening agent (if used), additional herbicide (if used), and Garlon 3A. Surfactant should be added to the spray tank last or as recommended on the product label. If combined with emulsifiable concentrate herbicides, moderate continuous adequate agitation is required.

Before using any recommended tank mixtures, read the directions and all use precautions on both labels.

For best results, apply when woody plants and weeds are actively growing. When hard to control species such as ash, blackgum, choke cherry, elm, maples, oaks, pines, or winged elm are prevalent and during applications made in late summer when the plants are mature and during drought conditions, use the higher rates of Garlon 3A alone or in combination with Tordon<sup>®</sup> 101 Mixture specialty herbicide. (Tordon 101 Mixture is a restricted use pesticide. See product label.) Tordon 101 Mixture is not registered for use in the states of California and Florida.

When using Garlon 3A in combination with 2,4-D 3.8 lb amine, like DMA 4 IVM, or low volatile ester herbicides, generally the higher rates should be used for satisfactory brush control.

Use the higher dosage rates when brush approaches an average of 15 feet in height or when the brush covers more than 60% of the area to be treated. If lower rates are used on hard to control species, resprouting may occur the year following treatment.

On sites where easy to control brush species dominate, rates less than those listed may be effective. Consult State or Local Extension personnel for such information.

## Foliage Treatment With Ground Equipment

### High Volume Foliage Treatment

For control of woody plants, use Garlon 3A at the rate of 3 to 9 lb ae of triclopyr (1 to 3 gallons of Garlon 3A) per 100 gallons of spray solution, or Garlon 3A at 3/4 to 3 lb ae of triclopyr (1 to 4 quarts of Garlon 3A) may be tank mixed with 1/4 to 1/2 gallons of 2,4-D 3.8 lb amine, like DMA 4 IVM, or low volatile ester or Tordon 101 Mixture and diluted to make 100 gallons of spray solution. Apply at a volume of 100 to 400 gallons of total spray per acre depending upon size and density of woody plants. Coverage should be thorough to wet all leaves, stems, and root collars. (See General Use Precautions and Restrictions.) Do not exceed maximum allowable use rates per acre (see table below). Tordon 101 Mixture is not registered for use in the states of California and Florida.

### Maximum Labeled Rate versus Spray Volume per Acre

Total Spray Volume (gal/acre)	Maximum Rate of Garlon 3A		
	Rangeland and Pasture Sites <sup>1</sup> (gal/100 gal of spray)	Forestry Sites <sup>2</sup> (gal/100 gal of spray)	Other Non-Cropland Sites <sup>3</sup> (gal/100 gal of spray)
400	Do not use	0.5	0.75
300	Do not use	0.67	1
200	Do not use	1	1.5
100	0.67	2	3
50	1.33	4	6
40	1.67	5	7.5
30	2.33	6.65	10
20	3.33	10	15
10	6.67	20	30

<sup>1</sup> Do not exceed the maximum use rate of 2 lb ae of triclopyr (2/3 gal of Garlon 3A)/acre/year.

<sup>2</sup> Do not exceed the maximum use rate of 6 lb ae of triclopyr (2 gal of Garlon 3A)/acre/year.

<sup>3</sup> Do not exceed the maximum use rate of 9 lb ae of triclopyr (3 gal of Garlon 3A)/acre/year on non-cropland use sites other than rangeland, pasture, forestry, and grazed areas.

### Low Volume Foliage Treatment

To control susceptible woody plants, apply up to 15 lb ae of triclopyr (5 gallons of Garlon 3A) in 10 to 100 gallons of finished spray. The spray concentration of Garlon 3A and total spray volume per acre should be adjusted according to the size and density of target woody plants and kind of spray equipment used. With low volume sprays, use sufficient spray volume to obtain uniform coverage of target plants including the surfaces of all foliage, stems, and root collars (see General Use Precautions and Restrictions). For best results, a surfactant should be added to all spray mixtures. Match equipment and delivery rate of spray nozzles to height and density of woody plants. When treating tall, dense brush, a truck mounted spray gun with spray tips that deliver up to 2 gallons per minute at 40 to 60 psi may be required. Backpack or other types of specialized spray equipment with spray tips that deliver less than 1 gallon of spray per minute may be appropriate for short, low to moderate density brush.

**Tank Mixing:** As a low volume foliar spray, up to 9 lb ae of triclopyr (3 gallons of Garlon 3A) may be applied in tank mix combination with 1/2 to 1 gallon of Tordon K or 1 to 2 gallons of Tordon 101 Mixture in 10 to 100 gallons of finished spray. Tordon 101 Mixture and Tordon K are not registered for use in the states of California and Florida.

## Broadcast Applications With Ground Equipment

Apply using equipment that will assure uniform coverage of the spray volumes applied. To improve spray coverage, add an agriculturally labeled non-ionic surfactant as described later under Directions for Use. See Maximum Labeled Rate versus Spray Volume per Acre table above for relationship between mixing rate, spray volume and maximum application rate.

### Woody Plant Control

**Foliage Treatment:** Use 6 to 9 lb ae of triclopyr (2 to 3 gallons of Garlon 3A) in enough water to make 20 to 100 gallons of total spray per acre or 1 1/2 to 3 lb ae of triclopyr (1/2 to 1 gallon of Garlon 3A) may be combined with 1 to 2 gallons of 2,4-D 3.8 lb amine, like DMA 4 IVM, or low volatile esters or Tordon 101 Mixture in sufficient water to make 20 to 100 gallons of total spray per acre. Tordon 101 Mixture is not registered for use in the states of California and Florida.

### Broadleaf Weed Control

Use Garlon 3A at rates of 1 to 4 1/2 lb ae of triclopyr (1/3 to 1 1/2 gallons of Garlon 3A) in a total volume of 20 to 100 gallons of water per acre. Apply any time during the growing season. Garlon 3A at 1 to 3 lb ae of triclopyr (1/3 to 1 gallon of Garlon 3A) may be tank mixed with 1/2 to 1 gallon of Tordon K, Tordon 101 Mixture or 2,4-D 3.8 lb amine, like DMA 4 IVM, or low volatile herbicides to improve the spectrum of activity. Tordon 101 Mixture and Tordon K are not registered for use in the states of California and Florida.

### Aerial Application (Helicopter Only)

Aerial sprays should be applied using suitable drift control. (See General Use Precautions and Restrictions.) Add an agriculturally labeled non-ionic surfactant as described under Directions for Use. See Maximum Labeled Rate versus Spray Volume per Acre table above for relationship between mixing rate, spray volume and maximum application rate.

### Foliage Treatment (Non-Grazed Rights-of-Way)

**Non-grazed areas:** Use 6 to 9 lb ae of triclopyr (2 to 3 gallons of Garlon 3A) or 3 to 4 1/2 lb ae of triclopyr (1 to 1 1/2 gallons of Garlon 3A) in a tank mix combination with 1 to 2 gallons of 2,4-D 3.8 lb amine, like DMA 4 IVM, or low volatile esters or Tordon 101 Mixture, and apply in a total spray volume of 10 to 30 gallons per acre. Use the higher rates and volumes when plants are dense or under drought conditions. Tordon 101 Mixture is not registered for use in the states of California and Florida.

Interspersed areas in non-grazed rights-of-ways that may be subject to grazing may be spot treated if the treated area comprises no more than 10% of the total grazable area.

### Forest Management Applications

For best control from broadcast applications of Garlon 3A, use a spray volume which will provide thorough plant coverage. Recommended spray volumes are usually 10 to 25 gallons per acre by air or 10 to 100 gallons per acre by ground. To improve spray coverage of spray volumes less than 50 gallons per acre, add an agriculturally labeled non-ionic surfactant as described under Directions for Use. Application systems should be used to prevent hazardous drift to off-target sites. Nozzles or additives that produce larger droplets of spray may require higher spray volumes to maintain brush control.

### Forest Site Preparation (Not for Conifer Release)

Use up to 6 lb ae of triclopyr (2 gallons of Garlon 3A) and apply in a total spray volume of 10 to 30 gallons per acre or Garlon 3A at 3 to 4 1/2 lb ae of triclopyr (1 to 1 1/2 gallons of Garlon 3A) may be used with 1 to 2 gallons of Tordon 101 Mixture or 2,4-D 3.8 lb low volatile ester in a tank mix combination in a total spray volume of 10 to 30 gallons per acre. Use a non-ionic agricultural surfactant for all foliar applications as described under Directions for Use. Tordon 101 Mixture is not registered for use in the states of California and Florida.

**Note:** Conifers planted sooner than one month after treatment with Garlon 3A at less than 4 lb ae of triclopyr (1 1/3 gallons of Garlon 3A) per acre or sooner than two months after treatment at 4 to 9 lb ae of triclopyr (1 1/3 to 3 gallons of Garlon 3A) per acre may be injured. When tank mixtures of herbicides are used for forest site preparation, labels for all products in the mixture should be consulted and the longest recommended waiting period before planting observed.

### Directed Spray Applications for Conifer Release

To release conifers from competing hardwoods such as red maple, sugar maple, striped maple, sweetgum, red and white oaks, ash, hickory, alder, birch, aspen, and pin cherry, mix 3 to 6 lb ae of triclopyr (1 to 2 gallons of Garlon 3A) in enough water to make 100 gallons of spray mixture. To improve spray coverage, add an agriculturally labeled non-ionic surfactant as described under Directions for Use. The spray mixture should be directed onto foliage of competitive hardwoods using knapsack or backpack sprayers with flat fan nozzles or equivalent any time after hardwoods have reached full leaf size, but before autumn coloration. The majority of treated hardwoods should be less than 6 feet in height to ensure adequate spray coverage. Care should be taken to direct spray away from contact with conifer foliage, particularly foliage of desirable pines.

**Note:** Spray may cause temporary damage and growth suppression where contact with conifers occurs; however, injured conifers should recover and grow normally. Over-the-top spray applications can kill pines.

### Broadcast Applications for Conifer Release in the Northeastern United States

To release spruce, fir, red pine and white pine from competing hardwoods, such as red maple, sugar maple, striped maple, alder, birch (white, yellow or gray), aspen, ash, pin cherry and *Rubus* spp. and perennial and annual broadleaf weeds, use Garlon 3A at rates of 1 1/2 to 3 lb ae of triclopyr (2 to 4 quarts of Garlon 3A) per acre alone or with 2,4-D amine, like DMA 4 IVM, or 2,4-D ester to provide no more than 4 lb ae per acre from both products. Apply in late summer or early fall after conifers have formed their overwintering buds and hardwoods are in full leaf and prior to autumn coloration.

### Broadcast Applications for Douglas Fir Release in the Pacific Northwest and California

To release Douglas fir from susceptible competing vegetation such as broadleaf weeds, alder, blackberry or Scotch broom, apply Garlon 3A at 1 to 1 1/2 lb ae of triclopyr (1 1/3 to 2 quarts of Garlon 3A) per acre alone or in combination with 4 lb per acre of atrazine. Mix all sprays in a water carrier with a non-ionic surfactant. Apply in early spring after hardwoods begin growth and before Douglas fir bud break ("early foliar" hardwood stage) or after Douglas fir seasonal growth has "hardened off" (set winter buds) in late summer, but while hardwoods are still actively growing. When treating after Douglas fir bud set, apply prior to onset of autumn coloration in hardwood foliage. **Note:** Treatments applied during active Douglas fir shoot growth (after spring bud break and prior to bud set) may cause injury to Douglas fir trees.

### Cut Surface Treatments

Individual plant treatments such as basal bark and cut surface applications may be used on any use site listed on this label at a maximum use rate of 2.67 gallons of Garlon 3A (8 lb ae of triclopyr) per acre. These types of applications are made directly to ungrazed parts of plants and, therefore, are not restricted by the grazing maximum rate of 2/3 of a gallon of Garlon 3A (2 lb ae of triclopyr) per acre.

To control unwanted trees of hardwood species such as elm, maple, oak and conifers in labeled sites, apply Garlon 3A, either undiluted or diluted in a 1 to 1 ratio with water, as directed below.

#### With Tree Injector Method

Apply by injecting 1/2 milliliter of undiluted Garlon 3A or 1 milliliter of the diluted solution through the bark at intervals of 3 to 4 inches between centers of the injector wound. The injections should completely surround the tree at any convenient height. **Note: No Worker Protection Standard worker entry restrictions or worker notification requirements apply when this product is injected directly into plants.**

#### With Hack and Squirt Method

Make cuts around the tree trunk at a convenient height with a hatchet or similar equipment so that the cuts overlap slightly and make a continuous circle around the trunk. Spray 1/2 milliliter of undiluted Garlon 3A or 1 milliliter of the diluted solution into the pocket created between the bark and the inner stem/trunk by each cut.

#### With Frill or Girdle Method

Make a single girdle through the bark completely around the tree at a convenient height. The frill should allow for the herbicide to remain next to the inner stem and absorb into the plant. Wet the cut surface with undiluted or diluted solution.

Both of the above methods may be used successfully at any season except during periods of heavy sap flow of certain species - for example, maples.

#### Stump Treatment

Spray or paint the cut surfaces of freshly cut stumps and stubs with undiluted Garlon 3A. The cambium area next to the bark is the most vital area to wet.

### Christmas Tree Plantations

Use Garlon 3A for the control of woody plants and annual and perennial broadleaf weeds in established Christmas tree plantations. For best results, apply when woody plants and weeds are actively growing. Garlon 3A does not control weeds which have not emerged at the time of application. If lower rates are used on hard to control woody species, resprouting may occur the year following treatment. Brush over 8 feet tall is difficult to treat efficiently using hand equipment such as backpack or knapsack sprayers. When treating large brush or trees or hard to control species such as ash, blackgum, choke cherry, elm, hazel, madrone, maples, oaks or sweetgum, and for applications made during drought conditions or in late summer when the leaves are mature, use the higher rates of Garlon 3A or use cut surface application methods. For foliar applications, apply in enough water to give uniform and complete coverage of the plants to be controlled. Applications made under drought conditions may provide less than desirable results.

**Use Precautions:**

- Do not use on newly seeded grass until well established as indicated by vigorous growth and development of secondary root system and tillering
- Newly seeded turf (alleyways, etc.) should be mowed two or three times before any treatment with Garlon 3A.
- Do not reseed Christmas tree areas treated with Garlon 3A for a minimum of three weeks after application.
- Do not use Garlon 3A if legumes, such as clover, are present and injury cannot be tolerated.

**Spray Preparation**

The order of addition to the spray tank is water, drift control agent (if used), non-ionic agricultural surfactant and Garlon 3A. Continue moderate agitation while mixing and spraying. Use a non-ionic agricultural surfactant for all applications. When using surfactants, follow use directions and precautions listed on the manufacturer's label. Use the higher recommended concentrations of surfactant in the spray mixture when applying lower spray volumes per acre.

**Application**

Apply in late summer or early autumn after terminal growth of Christmas trees has hardened off, but before leaf drop of, target weeds. Apply at a rate of 3/4 to 1 3/4 lb ae of triclopyr (2 to 5 pints of Garlon 3A) per acre as a foliar spray directed toward the base of Christmas trees. Use sufficient spray volume to provide uniform coverage of target plants (20 to 100 gallons per acre). **Do not apply with 2,4-D.** Application rates of Garlon 3A recommended for Christmas trees will only suppress some well established woody plants that are greater than 2 to 3 years old (see table below). Broadcast sprays may also be applied in bands between the rows of planted trees. Use spray equipment that will assure uniform coverage of the desired spray volume.

**Spray solution from Garlon 3A can cause needle and branch injury to Christmas trees.** To minimize injury to Christmas trees, direct sprays so as to minimize contact with foliage. Blue spruce, white spruce, balsam fir and Fraser fir are less susceptible to injury than white pine and Douglas fir.

**Restriction:** Apply Garlon 3A only to established Christmas trees that were planted at least one full year prior to application.

**Application Rates and Species Controlled:**

Garlon 3A		
2 pints/acre (3/4 lb ae of triclopyr)	3 to 4 pints/acre (1 1/2 lb ae of triclopyr)	5 pints/acre (1 3/4 lb ae of triclopyr)
clover	bindweed, field (TG)	arrowwood (SDL)
dandelion	blackberry <sup>1</sup>	aspens
dock, curly	chicory (S)	beech (SDL)
lambsquarters	fireweed	birch (SDL)
lespedeza	ivy, ground	chinquapin
plantain, broadleaf	lettuce, wild	cottonwood (SDL)
plantain, buckhorn	oxalis	elderberry
ragweed, common	poison ivy	grape, wild
vetch	smartweed (TG)	mulberry (SDL)
	thistle, Canada (TG)	poplar (SDL)
	violet, wild	sassafras (SDL)
	Virginia creeper <sup>†</sup>	sumac (SDL)
		sycamore (SDL)

(TG) Top growth control, retreatment may be necessary

(S) Suppression

(SDL) Seedlings less than 2 to 3 years old

<sup>1</sup>Use 4 pint per acre rate

**Directed Applications**

To control hardwoods such as red maple, sugar maple, striped maple, sweetgum, red and white oaks, ash, alder, birch, aspen, and pin cherry, mix 4 to 20 fl oz of Garlon 3A in enough water to make 3 gallons of spray mixture. For directed applications, do not exceed 6 lb ae of triclopyr (2 gallons of Garlon 3A) per acre per year. To improve coverage, add a non-ionic agricultural surfactant to the spray. This spray mixture should be directed onto foliage of competitive hardwoods using knapsack or backpack sprayers with flat fan nozzles or equivalent any time after hardwoods have reached full leaf size, but before autumn coloration (when plants are actively growing). The majority of treated hardwoods should be less than 8 feet in height to ensure adequate spray coverage.

**Note:** To prevent Christmas tree injury, care should be taken to direct spray away from contact with Christmas tree foliage.

**Cut Surface Treatments**

When treating large brush or trees or hard to control species such as ash, blackgum, choke cherry, elm, hazel, madrone, maples, oaks, salt cedar or sweetgum, and for applications made during drought conditions or in late summer when the leaves are mature, use cut surface treatments. (See directions for Cut Surface Treatments in preceding section of this label.)

**Wetland Sites in Production Forests and Industrial Non-Crop Areas**

Garlon 3A may be used within production forests and industrial non-crop sites to control target vegetation in and around standing water sites, such as marshes, wetlands, and the banks of ponds and lakes and transition areas between upland and lowland sites.

For control of woody plants and broadleaf weeds in these sites, follow use directions and application methods on this label for forestry and non-cropland sites.

**Use Precautions:**

Minimize overspray to open water when treating target vegetation in and around non-flowing, quiescent or transient water. When making applications to control unwanted plants on banks or shorelines of flowing water, minimize overspray to open water. **Note:** Consult local public water control authorities before applying this product in and around public water. Permits may be required to treat such areas.

**Terms and Conditions of Use**

If terms of the following Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies are not acceptable, return unopened package at once to the seller for a full refund of purchase price paid. Otherwise, use by the buyer or any other user constitutes acceptance of the terms under Warranty Disclaimer, Inherent Risks of Use and Limitations of Remedies.

**Warranty Disclaimer**

Dow AgroSciences warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. Dow AgroSciences MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.

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### **Inherent Risks of Use**

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It is impossible to eliminate all risks associated with use of this product. Plant injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label, such as unfavorable temperature, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner of application, or other factors, all of which are beyond the control of Dow AgroSciences or the seller. All such risks shall be assumed by buyer.

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### **Limitation of Remedies**

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The exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability, or other legal theories), shall be limited to, at Dow AgroSciences' election, one of the following:

1. Refund of purchase price paid by buyer or user for product bought, or
2. Replacement of amount of product used.

Dow AgroSciences shall not be liable for losses or damages resulting from handling or use of this product unless Dow AgroSciences is promptly notified of such loss or damage in writing. In no case shall Dow AgroSciences be liable for consequential or incidental damages or losses.

The terms of the Warranty Disclaimer, Inherent Risks of Use, and this Limitation of Remedies cannot be varied by any written or verbal statements or agreements. No employee or sales agent of Dow AgroSciences or the seller is authorized to vary or exceed the terms of the Warranty Disclaimer or this Limitation of Remedies in any manner.

\*Trademark of Dow AgroSciences LLC

**Produced for  
Dow AgroSciences LLC  
9330 Zionsville Road  
Indianapolis, IN 46268**

Label Code: D02-101-039  
Replaces Label: D02-101-038  
LOES Number: 010-00084

EPA accepted 01/03/06

# NAVIGATE®

## GRANULAR AQUATIC HERBICIDE FOR CONTROLLING CERTAIN UNWANTED AQUATIC PLANTS

### ACTIVE INGREDIENTS:

2,4-Dichlorophenoxyacetic acid, butoxyethyl ester.....27.6%

INERT INGREDIENTS: .....72.4%

TOTAL 100.0%

\*Isomer specific by AOAC method No. 6.D01-5

\*2,4-Dichlorophenoxyacetic acid equivalent 19% by weight

EPA Reg. No. 71368-4-8959

EPA Est. No. 407-IA-2

## KEEP OUT OF REACH OF CHILDREN CAUTION

For Chemical Emergency, Spill, Leak, Fire, Exposure or Accident  
Call Chemtrec Day or Night 1-800-424-9300

### STATEMENT OF PRACTICAL TREATMENT

**IF SWALLOWED:** Call a physician or Poison Control Center. Drink 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. If person is unconscious, do not give anything by mouth and do not induce vomiting.

**IF ON SKIN:** Wash with plenty of soap and water. Get medical attention.

**IF INHALED:** Remove victim to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. Get medical attention.

**IF IN EYES:** Flush eyes with plenty of water. Call a physician if irritation persists.

### PRECAUTIONARY STATEMENTS

#### CAUTION

#### HAZARDS TO HUMANS AND DOMESTIC ANIMALS

Harmful if swallowed, absorbed through skin, or inhaled. Causes eye irritation. Avoid contact with skin, eyes or clothing. Avoid breathing dust. When handling this product, wear chemical resistant gloves. Wash thoroughly with soap and water after handling.

When mixing, loading, or applying this product or repairing or cleaning equipment used with this product, wear eye protection (face shield or safety glasses), chemical resistant gloves, long-sleeved shirt, long pants, socks and shoes. It is recommended that safety glasses include front, brow and temple protection.

Wash hands, face and arms with soap and water as soon as possible after mixing, loading, or applying this product. Wash hands, face and hands with soap and water before eating, smoking or drinking. Wash hands and arms before using toilet. After work, remove all clothing and shower using soap and water. Do not reuse clothing worn during the previous day's mixing and loading or application of this product without cleaning first. Clothing must be kept and washed separately from other household laundry. Remove saturated clothing as soon as possible and shower.

#### ENVIRONMENTAL HAZARDS

This product is toxic to fish. Drift or runoff may adversely affect fish and non-target plants. Do not apply to water except as specified on this label. Do not contaminate water when disposing of equipment washwaters. Do not apply to waters used for irrigation, agricultural sprays, watering dairy animals or domestic water supplies.

Clean spreader equipment thoroughly before using it for any other purposes. Vapors from this product may injure susceptible plants in the immediate vicinity. Avoid drift of dust to susceptible plants.

**MIXING OR LOADING:** Most cases of ground water contamination involving phenoxy herbicides such as 2,4-D have been associated with mixing/loading and disposal sites. Caution should be exercised when handling 2,4-D pesticides at such sites to prevent contamination of ground water supplies. Use of closed systems for mixing or transferring this pesticide will reduce the probability of spills. Placement of the mixing/loading equipment on an impervious pad to contain spills will help prevent ground water contamination.

#### DIRECTIONS FOR USE

IT IS A VIOLATION OF FEDERAL LAW TO USE THIS PRODUCT IN A MANNER INCONSISTENT WITH ITS LABELING.

READ THIS ENTIRE LABEL BEFORE USING THIS PRODUCT

#### STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

#### STORAGE

Store in original container in a dry secured storage area.

#### PESTICIDE DISPOSAL

Pesticide wastes are toxic. Improper disposal of excess pesticide is a violation of Federal law and may contaminate ground water. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

#### CONTAINER DISPOSAL

Do not reuse empty bag. Completely empty bag into application equipment. Then dispose of empty bag in a sanitary landfill or by incineration, or, if allowed by State and local authorities, by burning. If bag is burned, stay out of smoke.

NAVIGATE is a trademark of Applied Biochemists

NET WT. 50 LBS. (22.68 KG)

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## GENERAL PRECAUTIONS AND RESTRICTIONS

Do not use in or near a greenhouse.

### OXYGEN RATIO

Fish breathe oxygen in the water and a water-oxygen ratio must be maintained. Decaying weeds use up oxygen, but during the period when NAVIGATE® should be used, the weed mass is fairly sparse and the weed decomposition rate is slow enough so that the water-oxygen ratio is not disturbed by treating the entire area at one time.

If treatments must be applied later in the season when the weed mass is dense and repeat treatments are needed spread granules in lanes, leaving buffer strips which can then be treated when vegetation in treated lanes has disintegrated. During the growing season, weeds decompose in a 2 to 3 week period following treatment. Buffer lanes should be 50 to 100 feet wide. Treated lanes should be as wide as the buffer strips.

### WATER pH

Best results are generally obtained if the water to be treated has a pH less than 8. A pH of 8 or higher may reduce weed control. If regrowth occurs within a period of 6 to 8 weeks, a second application may be needed.

### PERMIT TO USE CHEMICALS IN WATER

In many states, permits are required to control weeds by chemical means in public water. If permits are required, they may be obtained from the Chief, Fish Division, State Department of Conservation or the State Department of Public Health.

### GENERAL INFORMATION

NAVIGATE® is formulated on special heat treated attaclay granules that resist rapid decomposition in water, sink quickly to lake or pond bottoms and release the weed killing chemical in the critical root zone area.

This product is designed to selectively control the weeds listed on the label. While certain other weeds may be suppressed, control may be incomplete. Reduced control may occur in lakes where water replacement comes from bottom springs.

### WHEN TO APPLY

For best results, spread NAVIGATE® in the spring and early summer, during the time weeds start to grow. If desired, this timing can be checked by sampling the lake bottom in areas heavily infested with weeds the year before.

If treatments are delayed until weeds form a dense mat or reach the surface, two treatments may be necessary. Make the second treatment when weeds show signs of recovery.

Treatments made after September may be less effective depending upon water temperatures and weed growth.

Occasionally, a second application will be necessary if heavy regrowth occurs or weeds reinfest from untreated areas.

### HOW TO APPLY

**FOR LARGE AREAS:** Use a fertilizer spreader or mechanical seeder such as the Gerber or Gandy or other equipment capable of uniformly applying this product. Before spreading any chemical, calibrate your method of application to be sure of spreading the proper amount. When using boats and power equipment, you must determine the proper combination of (1) boat speed (2) rate of delivery from the spreader, and (3) width of swath covered by the granules.

**FOR SMALL AREAS:** (Around Docks or Isolated Patches of Weeds): Use a portable spreader such as the Cyclone seeder or other equipment capable of uniformly applying this product. Estimate or measure out the area you want to treat. Weight out the amount of material needed and spread this uniformly over the area. More uniform coverage is obtained by dividing the required amount in two and covering the area twice, applying the second half at right angles to the first.

Use the following formula to calibrate your spreader's delivery in pounds of NAVIGATE PER MINUTE:

$$\frac{\text{Miles per hour} \times \text{spreader width} \times \text{pounds per acre}}{495} = \text{pounds per minute}$$

Example: To apply 100 pounds of NAVIGATE per acre using a spreader that covers a 20 foot swath from a boat traveling at 4 miles per hour, set the spreader to deliver 16 pounds of NAVIGATE granules per minute.

$$\frac{4 \text{ mph} \times 20 \text{ feet} \times 100 \text{ Lbs./A}}{495} = 16 \text{ Lbs./Min.}$$

### AMOUNTS TO USE

Rates of application vary with resistance of weed species to the chemical, density of weed mass at time of treatment, stage of growth, water depth, and rate of water flow through the treated area. Use the higher rate for dense weeds, when water is more than 8 feet deep and where there is a large volume turnover.

	NAVIGATE POUNDS PER ACRE	NAVIGATE POUNDS PER 2000 SQ. FT.
<b>SUSCEPTIBLE WEEDS</b>		
Water Milfoil (Myriophyllum spp.)	100 TO 200	5
Water stargrass (Heteranthera dubia)		
<b>SLIGHTLY TO MODERATELY RESISTANT WEEDS</b>		
Bladderwort (Utricularia spp.)	150 to 200	7-1/2 to 10
White water Lily (Nymphaea spp.)		
Yellow water lily (Nuphar spp.)		
Or spatterdock*		
Water shield (Brasenia spp.)		
Water chestnut (Trapa natans)		
Coontail* (Ceratophyllum Demersum)		

- Repeat treatments may be needed

### LIMITED WARRANTY AND DISCLAIMER

The manufacturer warrants (a) that this product conforms to the chemical description on the label; (b) that this product reasonably fit for the purposes set forth in the directions for use when it is used in accordance with such directions; and (c) that the directions, warning and other statements on the label are based upon responsible experts' evaluation of reasonable tests of effectiveness, of toxicity to laboratory animals and to plants, and of residues on food crops and upon reports of field experience. Tests have not been made on all varieties or in all states or under all conditions. THE MANUFACTURER NEITHER MAKES NOR INTENDS, NOR DOES IT AUTHORIZE ANY AGENT OR REPRESENTATIVE TO MAKE, ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, AND IT EXPRESSLY EXCLUDES AND DISCLAIMS ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

THIS WARRANTY DOES NOT EXTEND TO, AND THE BUYER SHALL BE SOLELY RESPONSIBLE FOR, ANY AND ALL LOSS OR DAMAGE WHICH RESULTS FROM USE OF THIS PRODUCT IN ANY MANNER WHICH IS INCONSISTENT WITH THE LABEL DIRECTIONS, WARNINGS OR CAUTIONS.

BUYER'S EXCLUSIVE REMEDY AND MANUFACTURER'S OR SELLER'S EXCLUSIVE LIABILITY FOR ANY AND ALL CLAIMS, LOSSES, DAMAGES, OR INJURIES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT, WHETHER OR NOT BASED IN CONTRACT, NEGLIGENCE, STRICT LIABILITY IN TORT OR OTHERWISE SHALL BE LIMITED. AT THE MANUFACTURER'S OPTION, TO REPLACEMENT OF, OR THE REPAYMENT OF THE PURCHASE PRICE FOR, THE QUANTITY OF PRODCUT WITH RESPECT TO WHICH DAMAGES ARE CLAIMED. IN NO EVENT SHALL MANUFACTURER OR SELLER BE LIABLE FOR SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT.

### NOTICE TO BUYER

Purchase of this material does not confer any rights under patents governing this product or the use thereof in countries outside of the United States.

MANUFACTURED FOR:

applied biochemists  
MILWAUKEE, WI 1-800-558-5106

# Specimen Label

# Renovate® OTF

## Aquatic Herbicide



**Aquatic Sites:** For control of emerged, submersed and floating aquatic weeds in the following aquatic sites: ponds; lakes; reservoirs; marshes; wetlands; impounded rivers, streams and other bodies of water that are quiescent; non-irrigation canals, seasonal irrigation waters and ditches which have little or no continuous outflow.

For use in New York State, comply with Section 24(c) Special Local Need labeling for Renovate® OTF, SLN NY-070004

**Active Ingredient:**

triclopyr: 3,5,6-trichloro-2-pyridinyloxyacetic acid,	
triethylamine salt . . . . .	14.0%
Other Ingredients . . . . .	86.0%
<b>TOTAL . . . . .</b>	<b>100.0%</b>

Acid equivalent: triclopyr - 10.0%.

## Keep Out of Reach of Children CAUTION / PRECAUCIÓN

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

### Precautionary Statements

#### Hazards to Humans and Domestic Animals

Causes moderate eye irritation. Avoid contact with eyes or clothing.

#### USER SAFETY RECOMMENDATIONS

**Users should:**

- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.
- Remove clothing immediately if pesticide gets inside, then wash thoroughly and put on clean clothing.

First Aid	
<b>If in eyes</b>	<ul style="list-style-type: none"><li>• Hold eye open and rinse slowly and gently with water for 15 - 20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.</li><li>• Call a poison control center or doctor for treatment advice.</li></ul>
<b>If on skin or clothing</b>	<ul style="list-style-type: none"><li>• Take off contaminated clothing.</li><li>• Rinse skin immediately with plenty of water for 15 - 20 minutes.</li><li>• Call a poison control center or doctor for treatment advice.</li></ul>
<b>If swallowed</b>	<ul style="list-style-type: none"><li>• Call a poison control center or doctor immediately for treatment advice.</li><li>• Have person sip a glass of water if able to swallow.</li><li>• Do not induce vomiting unless told to do so by a poison control center or doctor.</li><li>• Do not give anything by mouth to an unconscious person.</li></ul>
<b>If inhaled</b>	<ul style="list-style-type: none"><li>• Move person to fresh air.</li><li>• If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible.</li><li>• Call a poison control center or doctor for further treatment advice.</li></ul>
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. In case of emergency endangering health or the environment involving this product, call <b>INFOTRAC</b> at <b>1-800-535-5053</b> .	

**Notice:** Read the entire label. Use only according to label directions. **Before using this product, read “Warranty Disclaimer”, “Inherent Risks of Use”, and “Limitation of Remedies” at end of label booklet. If terms are unacceptable, return at once unopened.**

If you wish to obtain additional product information, please visit our web site at [www.sepro.com](http://www.sepro.com).

EPA Reg. No. 67690-42  
FPL 011808

Renovate is a registered trademark of Dow AgroSciences LLC.  
Manufactured by: **SePRO Corporation** 11550 North Meridian Street, Suite 600  
Carmel, IN 46032 U.S.A.

## ENVIRONMENTAL HAZARDS

Under certain conditions, treatment of aquatic weeds can result in oxygen depletion or loss due to decomposition of dead plants, which may cause fish suffocation. Therefore, to minimize this hazard **DO NOT** treat more than one-half (1/2) of the water area in a single operation *and* wait at least 10 days between treatments when susceptible plants are mature and have grown to the water's surface, or when the treatment would result in significant reductions in total plant biomass. Begin treatment along the shore and proceed outwards in bands to allow fish to move into untreated areas. Consult with the State agency for fish and game before applying to public water to determine if a permit is needed.

**AGRICULTURAL CHEMICAL:** Do not ship or store with food, feeds, drugs or clothing.

## Directions for Use

**It is a violation of Federal law to use this product in a manner inconsistent with its labeling.**

Read all *Directions for Use* carefully before applying.

**Do not** apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your state or tribe, consult the agency responsible for pesticide regulation.

## General Information

When applying this product follow all applicable use directions, precautions and limitations.

**For Aquatic and Wetland Sites:** Use Renovate OTF Granular herbicide for control of emersed, submersed and floating aquatic weeds in the following aquatic sites: ponds; lakes; reservoirs; marshes; wetlands; impounded rivers, streams and other bodies of water that are quiescent; non-irrigation canals, seasonal irrigation waters and ditches which have little or no continuous outflow.

**Obtain Required Permits:** Consult with appropriate state or local water authorities before applying this product in and around public waters. State or local public agencies may require permits.

**Recreational Use of Water in Treatment Area:** There are no restrictions on use of water in the treatment area for recreational purposes, including swimming and fishing.

**Livestock Use of Water from Treatment Area:** There are no restrictions on livestock consumption of water from the treatment area.

## GENERAL USE PRECAUTIONS AND RESTRICTIONS

**Chemigation:** Do not apply this product through any type of irrigation system.

**Irrigation:** Water treated with Renovate OTF may not be used for irrigation purposes for 120 days after application or until triclopyr residue levels are determined by laboratory analysis, or other appropriate means of analysis, to be 1.0 ppb or less. This label describes both required and recommended uses of a chemical analysis for the active ingredient, triclopyr. SePRO Corporation recommends the use of an Enzyme-Linked Immunoassay (ELISA) test for the determination of the active ingredient concentration in water. Contact SePRO Corporation for the incorporation of this analysis in your treatment program. Other proven chemical analysis for the active ingredient may also be used. The ELISA analysis is referenced in this label as the preferred method for the rapid determination of the concentration of the active ingredient in the water.

– **Seasonal Irrigation Waters:** Renovate OTF may be applied during the off-season to surface waters that are used for irrigation on a seasonal basis, provided that there is a minimum of 120 days between Renovate OTF application and the first use of treated water for irrigation purposes

or until triclopyr residue levels are determined by laboratory analysis, or other appropriate means of analysis, to be 1.0 ppb or less.

– **Irrigation Canals/Ditches:** Do not apply Renovate OTF to irrigation canals/ditches unless the 120 day restriction on irrigation water usage can be observed or triclopyr residue levels are determined by laboratory analysis, or other appropriate means of analysis, to be 1.0 ppb or less.

– **There is no restriction on use of treated water to irrigate established grasses.**

- **Do not** apply Renovate OTF directly to, or otherwise permit it to come into direct contact with grapes, tobacco, vegetable crops, flowers, or other desirable broadleaf plants, and do not permit dust to drift into these areas.
- **Do not** apply to salt water bays or estuaries.
- **Do not** apply directly to un-impounded rivers or streams.
- **Do not** apply on ditches or canals currently being used to transport irrigation water or that will be used for irrigation within 120 days following treatment or until triclopyr residue levels are determined to be 1.0 ppb or less.
- **Do not** apply where runoff water may flow onto agricultural land as injury to crops may result.

### Grazing and Haying Restrictions:

Except for lactating dairy animals, there are no grazing restrictions following application of this product.

- **Grazing Lactating Dairy Animals:** Do not allow lactating dairy animals to graze treated areas until the next growing season following application of this product.
- **Do not** harvest hay for 14 days after application.
- Grazed areas of non-cropland and forestry sites may be spot treated if they comprise no more than 10% of the total grazable area.

**Slaughter Restrictions:** During the season of application, withdraw livestock from grazing treated grass at least 3 days before slaughter.

## BEST MANAGEMENT PRACTICES FOR DRIFT MANAGEMENT

Equipment used in the application of Renovate OTF should be carefully calibrated to be sure it is working properly and delivering a uniform distribution pattern. Aerial application should be made only when the wind velocity is 2 to 10 mph.

Applications should be made only when there is little or no hazard for volatility or dust drift, and when application can maintain Renovate OTF placement in the intended area. Very small quantities of dust, which may not be visible, may seriously injure susceptible plants, and Renovate OTF may be blown outside of the intended treatment area under extreme conditions. **Do not** spread Renovate OTF when wind is blowing toward susceptible crops or ornamental plants that are near enough to be injured.

Avoiding drift at the application site is the responsibility of the applicator. The interaction of many equipment and weather related factors determine the potential for drift. The applicator is responsible for considering all these factors when making decisions.

**Ground Application Equipment:** To aid in reducing drift, Renovate OTF should be applied when wind velocity is low (follow state regulations; see *Sensitive Area* under *Aerial Drift Reduction Advisory* below) or using a slurry injection system.

## AERIAL DRIFT REDUCTION ADVISORY

This section is advisory in nature and does not supersede the mandatory label requirements.

**Application Height:** Applications should not be made at a height greater than 10 feet above the top of the largest plants unless a greater height is required for aircraft safety. Making applications at the lowest height that is safe reduces drift potential.

**Swath Adjustment:** When applications are made with a crosswind, the swath will be displaced downwind. Therefore, on the up and downwind edges of the field, the applicator must compensate for this displacement by

adjusting the path of the aircraft upwind. Swath adjustment distance should increase, with increasing drift potential (e.g. higher wind).

**Wind:** Drift potential is lowest between wind speeds of 2 - 10 mph (follow state regulations). However, many factors, including equipment type, determine drift potential at any given speed. Application should be avoided below 2 mph due to variable wind direction and high inversion potential.

**Note:** Local terrain can influence wind patterns. Every applicator should be familiar with local wind patterns and how they affect drift.

**Sensitive Areas:** Renovate OTF should only be applied when the potential for drift to adjacent sensitive areas (e.g., residential areas, known habitat for threatened or endangered species, non-target crops) is minimal (e.g., when wind is blowing away from the sensitive areas).

### AQUATIC WEEDS CONTROLLED BY RENOVATE OTF

alligatorweed	pennywort
American lotus	smartweed
bladderwort	water chestnut <sup>†,††</sup>
Eurasian watermilfoil	yellow water lily ( <i>Nuphar</i> spp., spatterdock)
milfoil species	white water lily ( <i>Nymphaea</i> spp.)
parrotfeather <sup>††</sup>	water primrose ( <i>Ludwigia</i> spp.)
pickerelweed	watershield ( <i>Brasenia</i> spp.)

<sup>†</sup> Not for use in California.

<sup>††</sup> Retreatment may be needed to achieve desired level of control.

## Application Methods

### Surface Application

Use a mechanical spreader such as a fertilizer spreader or mechanical seeder, or similar equipment capable of uniformly applying Renovate OTF. Before spreading any product, carefully calibrate the application equipment. When using boats and power equipment, you must determine the proper combination of (1) boat speed, (2) rate of delivery from the spreader, and (3) width of swath covered by the granules.

Use the following formula to calibrate the spreader's delivery in pounds of Renovate OTF per minute:

$$\frac{\text{miles per hour} \times \text{swath width (feet)} \times \text{pounds per acre}}{495} = \text{pounds per minute}$$

### Aerial Application (Helicopter Only)

Ensure uniform application. All equipment should be properly calibrated using blanks with similar physical characteristics to Renovate OTF. To avoid streaked, uneven or overlapped application, use an appropriate tracking device (e.g. GPS). Refer to the *Aerial Drift Reduction Advisory* section of this label for additional precautions and instructions for aerial application.

### Floating and Emerged Weeds

For control of water lily's (*Nymphaea* spp. and *Nuphar* spp.), watershield (*Brasenia* spp.), and other susceptible emerged and floating herbaceous weeds, apply 1.0 to 2.5 ppm a.e. triclopyr per acre. Apply when plants are actively growing.

Use higher rates in the rate range when plants are mature, when the weed mass is dense, in areas of greater water exchange, or for difficult to control species. Repeat as necessary to control regrowth, but do not exceed a total of 2.5 ppm a.e. triclopyr for the treatment area per annual growing season.

### Submersed Weeds

**For control of Eurasian watermilfoil (*Myriophyllum spicatum*) and other susceptible submersed weeds in ponds, lakes, reservoirs, impounded rivers, streams, and other bodies of water that are quiescent; non-irrigation canals, and seasonal irrigation waters, or ditches that have little or no continuous outflow, apply Renovate OTF using mechanical or portable granule spreading equipment. Rates should be selected according to the rate chart below to provide a triclopyr concentration of 0.50 to 2.5 ppm a.e. in treated water. Use of higher rates in the rate range is recommended in areas of greater water exchange. These areas may require a repeat application. However, total application**

of Renovate OTF must not exceed an application rate of 2.5 ppm a.e. triclopyr for the treatment area per annual growing season.

For optimal control, apply when Eurasian watermilfoil or other submersed weeds are actively growing.

### Concentration of Triclopyr Acid in Water (ppm a.e.)

Avg. Water Depth (ft)	Pounds Renovate OTF / acre					
	0.5 ppm	0.75 ppm	1.0 ppm	1.5 ppm	2.0 ppm	2.5 ppm
1	14	20	27	41	54	67
2	27	41	54	81	108	135
3	41	61	81	122	162	202
4	54	81	108	162	216	270

For applications greater in depth than 4 feet, when targeting difficult to control species and/or in sites with high dilution potential, the following formula should be used to calculate applications rates should greater than 270 pounds of Renovate OTF be needed to achieve desired weed control. **NOTE: Do not exceed 2.5 ppm a.e. triclopyr for the treatment area per annual growing season.**

$$\text{average depth} \times \text{target ppm} \times 27 = \text{pounds of Renovate OTF per acre}$$

### Example Calculation:

6 foot average depth x 2.5 ppm x 27 = 405 pounds of Renovate OTF per acre

### SMALL SITE (LESS THAN 1/2 ACRE) / SPOT TREATMENT APPLICATION

**For small treatment sites of 1/2 acre or less** use the rate chart below to determine the application rate depending on average water depth to achieve a concentration of 1.25 to 2.5 ppm a.e. **Do not exceed 2.5 ppm a.e. triclopyr** for the treatment area per annual growing season. Use higher rates in small treatment areas and in areas prone to higher dilution and for heavy weed infestation. Use the lower rates for spot treatment application of areas less prone to dilution and lighter weed infestations. For best results, split the total application rate into three equal applications 8 to 12 hours apart. Apply when water is calm.

**Example:** A 100 ft. by 40 ft. lakeshore swimming area with a 4 ft. average depth, heavily infested with Eurasian watermilfoil

Step 1: Determine the area to be treated in square feet (ft<sup>2</sup>) by multiplying the length of the area by the width.

$$- 100 \text{ ft.} \times 40 \text{ ft.} = 4,000 \text{ ft}^2$$

Step 2: Determine the amount of Renovate OTF to be used by consulting the Renovate OTF Rate Chart for Areas Less than 1/2 Acre.

- Use 24.7 lbs. of Renovate OTF total based on 4 foot average depth in Rate Chart below.

Step 3: Apply Renovate OTF uniformly over weeds in treatment site in three equal applications of 8.2 lbs. each, 8 - 12 hours apart.

### Renovate OTF Rate Chart for Areas Less than 1/2 Acre

Area (ft <sup>2</sup> )	Pounds Renovate OTF			
	3 foot average depth		4 foot average depth	
	1.25 ppm a.e.	2.5 ppm a.e.	1.25 ppm a.e.	2.5 ppm a.e.
500	1.2	2.3	1.5	3.0
1,000	2.3	4.6	3.1	6.1
4,000	9.3	18.6	12.4	24.7
10,000	23.2	46.5	31.0	61.9
20,000	46.5	93.0	62.0	123.9

For applications with an area or depth not included in the above chart, the following formula should be used to calculate application rates.

$$\text{area (ft}^2\text{)} / 43,560 \times \text{average depth} \times \text{target ppm} \times 27 = \text{pounds of Renovate OTF}$$

### Example Calculation:

8,250 ft<sup>2</sup>/43,560 x 4 foot average depth x 1.25 ppm x 27 = 25.6 pounds of Renovate OTF

Small treatment application of Renovate OTF is recommended with waterproof gloves or a hand spreader to uniformly distribute flakes on target weeds.

### Precautions for Potable Water Intakes:

For applications of Renovate OTF to control floating, emersed, and submersed weeds in sites that contain a functioning potable water intake for human consumption, see the chart below to determine the minimum setback distances of the application from the functioning potable water intakes.

Concentration of Triclopyr Acid in Water (ppm a.e.)					
Area Treated (acres)	Required Setback Distance (ft) from Potable Water Intake				
	0.75 ppm	1.0 ppm	1.5 ppm	2.0 ppm	2.5 ppm
<4	300	400	600	800	1000
>4 - 8	420	560	840	1120	1400
>8 - 16	600	800	1200	1600	2000
>16 - 32	780	1040	1560	2080	2600
>32 acres, calculate a setback using the formula for the appropriate rate	Setback (ft) = $\frac{(800 \cdot \ln(\text{acres}) - 160)}{/3.33}$	Setback (ft) = $\frac{(800 \cdot \ln(\text{acres}) - 160)}{/2.50}$	Setback (ft) = $\frac{(800 \cdot \ln(\text{acres}) - 160)}{/1.67}$	Setback (ft) = $\frac{(800 \cdot \ln(\text{acres}) - 160)}{/1.25}$	Setback (ft) = $\frac{(800 \cdot \ln(\text{acres}) - 160)}{}$

Note: ln = natural logarithm

### Example Calculation 1:

to apply 2.5 ppm Renovate OTF to 50 acres:

$$\begin{aligned} \text{Setback in feet} &= (800 \times \ln(50 \text{ acres}) - 160) \\ &= (800 \times 3.912) - 160 \\ &= 2970 \text{ feet} \end{aligned}$$

### Example Calculation 2:

to apply 0.75 ppm Renovate OTF to 50 acres:

$$\begin{aligned} \text{Setback in feet} &= \frac{(800 \times \ln(50 \text{ acres}) - 160)}{3.33} \\ &= \frac{(800 \times 3.912) - 160}{3.33} \\ &= 892 \text{ feet} \end{aligned}$$

Note: Existing potable water intakes which are no longer in use, such as those replaced by potable water wells or connections to a municipal water system, are not considered to be functioning potable water intakes.

To apply Renovate OTF around and within the distances noted above from a functioning potable water intake, the intake must be turned off until the triclopyr level in the intake water is determined to be 0.4 parts per million (ppm) or less by laboratory analysis or immunoassay.

### WETLAND SITES

Wetlands include flood plains, deltas, marshes, swamps, bogs, and transitional areas between upland and lowland sites. Wetlands may occur within forests, wildlife habitat restoration and management areas and similar sites as well as areas adjacent to or surrounding domestic water supply reservoirs, lakes and ponds.

For control of emersed, floating or submersed aquatic weeds in wetland sites, follow use directions and application methods associated with the *Floating and Emersed Weeds* or *Submersed Weeds* sections on this label.

### Use Precautions

Minimize unintentional application to open water when treating target vegetation in wetland sites. Note: Consult local public water control authorities before applying this product in and around public water. Permits may be required to treat such areas.

**IF ANY CONTENT ON THIS LABEL IS NOT UNDERSTOOD, OR YOU NEED FURTHER ASSISTANCE, CONTACT A SEPRO AQUATIC SPECIALIST WITH QUESTIONS SPECIFIC TO YOUR APPLICATION.**

## Terms and Conditions of Use

If terms of the following *Warranty Disclaimer*, *Inherent Risks of Use*, and *Limitation of Remedies* are not acceptable, return unopened package at once to the seller for a full refund of purchase price paid. Otherwise, use by the buyer or any other user constitutes acceptance of the terms under *Warranty Disclaimer*, *Inherent Risks of Use* and *Limitations of Remedies*.

## Warranty Disclaimer

SePRO Corporation warrants that the product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. SEPRO CORPORATION MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.

## Inherent Risks of Use

It is impossible to eliminate all risks associated with use of this product. Plant injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label such as unfavorable temperatures, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner of application, or other factors, all of which are beyond the control of SePRO Corporation as the seller. To the extent permitted by applicable law all such risks shall be assumed by buyer.

## Limitation of Remedies

To the fullest extent permitted by law, SePRO Corporation shall not be liable for losses or damages resulting from this product (including claims based on contract, negligence, strict liability, or other legal theories) shall be limited to, at SePRO Corporation's election, one of the following:

1. Refund of purchase price paid by buyer or user for product bought, or
2. Replacement of amount of product used.

SePRO Corporation shall not be liable for losses or damages resulting from handling or use of this product unless SePRO Corporation is promptly notified of such losses or damages in writing. In no case shall SePRO Corporation be liable for consequential or incidental damages or losses.

The terms of the *Warranty Disclaimer* above and this *Limitation of Remedies* cannot be varied by any written or verbal statements or agreements. No employee or sales agent of SePRO Corporation or the seller is authorized to vary or exceed the terms of the *Warranty Disclaimer* or *Limitations of Remedies* in any manner.

## Storage and Disposal

Nonrefillable container. Do not reuse or refill this container. Offer for recycling if available. Do not contaminate water, food, or feed by storage and disposal. Open dumping is prohibited.

**Pesticide Storage:** Store in original container. Do not store near food or feed. In case of leak or spill, contain material and dispose as waste.

**Pesticide Disposal:** Wastes resulting from the use of this product must be disposed of on site or at an approved waste disposal facility.

**Container Disposal (Plastic Bags):** Completely empty bag into application equipment. Then dispose of empty bag in a sanitary landfill or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

**General:** Consult federal, state, or local disposal authorities for approved alternative procedures.

# Specimen Label

# Renovate<sup>®</sup> MAX G

Aquatic Herbicide



**FOR CONTROL OF AQUATIC WEEDS IN PONDS; LAKES; RESERVOIRS; MARSHES; BAYOUS; DRAINAGE DITCHES; NON-IRRIGATION CANALS; AND RIVERS AND STREAMS THAT ARE QUIESCENT OR SLOW-FLOWING.**

### Active Ingredient

triclopyr: 3,5,6-trichloro-2-pyridinyloxyacetic acid,  
triethylamine salt.....4.0%  
2,4-dichlorophenoxyacetic acid, dimethylamine salt.....14.0%

Other Ingredients.....82.0%

**TOTAL**.....100.0%

Acid equivalence (a.e.): 14.4%

**NOTICE:** Read the entire label. Use only according to label directions. **Before using this product, read *Warranty Disclaimer, Inherent Risks of Use and Limitation of Remedies* at end of label booklet. If terms are unacceptable, return at once unopened.**

For additional information on our products, please visit [www.sepro.com](http://www.sepro.com).

EPA Reg. No. 67690-50  
FPL061209  
Renovate is a registered trademark of Dow AgroSciences LLC.  
SePRO Corporation 11550 N. Meridian Street, Suite 600, Carmel, IN 46032 U.S.A.

## Precautionary Statements

### Hazards to Humans and Domestic Animals

Causes substantial, but temporary eye injury. Harmful if swallowed. Avoid contact with skin or clothing. Do not get in eyes or on clothing. Wear protective eyewear (goggles, face shield, or safety glasses). Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, or using tobacco. Remove and wash contaminated clothing before reuse. Wear long-sleeved shirt and long pants, socks, and shoes.

## Keep Out of Reach of Children WARNING / AVISO

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

### FIRST AID

<b>If in eyes</b>	<ul style="list-style-type: none"><li>• Hold eye open and rinse slowly and gently with water for 15 - 20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.</li><li>• Call a poison control center or doctor for treatment advice.</li></ul>
<b>If swallowed</b>	<ul style="list-style-type: none"><li>• Call a poison control center or doctor immediately for treatment advice.</li><li>• Have person sip a glass of water if able to swallow.</li><li>• Do not induce vomiting unless told to do so by a poison control center or doctor.</li><li>• Do not give anything by mouth to an unconscious person.</li></ul>
<b>If inhaled</b>	<ul style="list-style-type: none"><li>• Move person to fresh air.</li><li>• If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible.</li><li>• Call a poison control center or doctor for further treatment advice.</li></ul>
<b>If on skin or clothing</b>	<ul style="list-style-type: none"><li>• Take off contaminated clothing.</li><li>• Rinse skin immediately with plenty of water for 15 - 20 minutes.</li><li>• Call a poison control center or doctor for treatment advice.</li></ul>

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. In case of emergency endangering health or the environment involving this product, call **INFOTRAC** at **1-800-535-5053**.

**Note to Physician:** Probable mucosal damage may contraindicate the use of gastric lavage.

### PERSONAL PROTECTIVE EQUIPMENT (PPE)

All loaders, applicators, and other handlers must wear:

- Long-sleeve shirt and long pants;
- Shoes and socks; and
- Protective eyewear.

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

## USER SAFETY RECOMMENDATIONS

### Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.
- Remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. If pesticide gets on skin, wash immediately with soap and water.
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

## ENGINEERING CONTROLS

Pilots must use an enclosed cockpit that meets the requirements listed in the WPS for agricultural pesticides [40 CFR 170.240(d)(6)].

## ENVIRONMENTAL HAZARDS

Fish breathe dissolved oxygen in the water and decaying weeds also use oxygen. When treating continuous, dense weed masses, it may be appropriate to treat only part of the infestation at a time. For example, in quiescent waters, apply the product to areas separated by untreated sections that can be treated after vegetation in treated areas has disintegrated. During the growing season, weeds decompose in a 2 to 4 week period following treatment. Begin treatment along the shore and proceed outwards in bands to allow fish to move into untreated areas. Waters having limited and less dense weed infestations may not require partial treatments.

**AGRICULTURAL CHEMICAL:** Do not ship or store with food, feeds, drugs or clothing.

## Directions for Use

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. Read all Directions for Use carefully before applying.

## GENERAL INFORMATION

Renovate MAX G herbicide may be applied directly to water for the control of aquatic weeds. Renovate MAX G enhances target weed control, and provides selective control of many broadleaf weeds in: ponds; lakes; reservoirs; marshes; bayous; drainage ditches; non-irrigation canals; and rivers and streams that are quiescent or slow-flowing.

Renovate MAX G is formulated on biodegradable granules that, when applied to water bodies, immediately delivers Renovate MAX G down to the critical area for controlling target weeds. Renovate MAX G is quickly absorbed from the water through plant stems and foliage and from the hydrosol by roots. Herbicidal symptoms are initially expressed 2 to 14 days following application and usually involve bending and twisting of apical sections and shoots of susceptible plants. Initial symptoms are followed by necrosis of terminal buds and above ground tissue.

Generally, target plants are controlled within 2 to 4 weeks after treatment, but depending on conditions and plant species can take up to 8 weeks for complete control.

When applying Renovate MAX G follow all applicable use directions, precautions and limitations. All Renovate MAX G concentrations referred to in this label are based on acid equivalence (a.e.).

**Obtain Required Permits:** Consult with the State or local agency with primary responsibility for pesticide regulation before applying to public waters to determine if a permit or public notification is required.

**Recreational Use of Water in Treatment Area:** There are no restrictions on the use of treated water for recreational purposes, including swimming, fishing and domestic purposes.

**Livestock Use of Water from Treatment Area:** There are no restrictions on consumption of treated water for potable use by livestock, pets, or other animals.

## GENERAL USE PRECAUTIONS AND RESTRICTIONS

- **Do not** apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.
- **Do not** enter or allow people (or pets) to enter the treated area until dusts have settled.
- For requirements specific to your State or Tribe, consult the State or Tribal agency responsible for pesticide regulation.
- **Chemigation: Do not** apply Renovate MAX G through any type of irrigation system.
- **Do not** apply to salt water bays or estuaries.
- Applications to target areas are limited to two (2) per season.
- Apply a maximum of 93.7 pounds of Renovate MAX G (13.5 lbs a.e.)/acre-foot per application. **Do not** exceed 5.0 ppm during any single application.
- **Do not** apply within 21 days of previous application except when conducting split treatments. Split treatments, over relatively short periods of time (e.g. 1 to 4 days), may be effective in some areas to maintain adequate exposure with target plants, such as small sites or sites with higher dilution potential.
- When treating moving bodies of water, applications must be made while traveling upstream to prevent concentration of herbicide downstream from the application.

## APPLICATION TO WATERS USED FOR IRRIGATION

### Irrigation Restrictions

- **Do not** use treated water for irrigating greenhouse or nursery plants unless triclopyr and 2,4-D residues are confirmed to be less than 1 ppb by laboratory analysis.
- **Do not** use water treated with Renovate MAX G for hydroponic farming.
- **Do not** apply Renovate MAX G directly to, or otherwise permit it to come into direct contact with grapes, tobacco, vegetable crops, flowers, or other desirable susceptible broadleaf plants, and do not permit dust to drift into these areas.
- This label describes both required and recommended uses of a chemical analyses for the active ingredients, triclopyr and 2,4-D. SePRO Corporation recommends the use of an Enzyme-Linked Immunoassay (ELISA) test for the determination of Renovate MAX G concentration in water. Contact SePRO Corporation for the incorporation of these analyses into your treatment program. Other proven chemical analysis for the active ingredients may also be used. The ELISA analysis is referenced in this label as the preferred method for the rapid determination of the concentration of the active ingredients in the water. Both triclopyr and 2,4-D can be analyzed from a single water sample.
- If Renovate MAX G treated water is intended to be used only for crops or non-crop areas that are labeled for direct treatment with triclopyr and 2,4-D such as pastures, turf, or established grasses, the treated water may be used to irrigate and/or mix sprays for these sites at any time during and after application.
- Due to potential phytotoxicity and/or residue considerations, the following restrictions are applicable to other uses of irrigation water:
  - If treated water is intended to be used to irrigate or mix sprays for crops not labeled for direct treatment with triclopyr and 2,4-D, the water must not be used unless **one** of the following restrictions has been observed:
    - A waiting period of 120 days from the time of application has elapsed; or
    - An approved assay indicates that the triclopyr concentration is 1.0 ppb or less and the 2,4-D concentration is 100 ppb or less at the water intake. See Table 2 (*SAMPLING FOR DRINKING WATER ANALYSES*) for the recommended waiting periods after application but before taking the initial water sample at water intake.
  - If treated water is intended to be used to irrigate non-crop areas not labeled for direct treatment with triclopyr and 2,4-D (e.g. landscape ornamentals) or for other irrigation uses not described, consult with SePRO Corporation prior to commencing irrigation if triclopyr concentrations exceed 1.0 ppb and 2,4-D concentrations are greater than 100 ppb.

## APPLICATIONS TO POTABLE WATER SOURCES

### Potable Water Restrictions

- The potable water use restrictions on this label are to ensure that consumption of water by the public is allowed only when the concentration of triclopyr in water is less than 400 ppb and the concentration of 2,4-D in water is less than the MCL (Maximum Contaminant Level) of 70 ppb. Applicators should consider the unique characteristics of the treated waters to assure that triclopyr and 2,4-D concentrations in potable water do not exceed 400 ppb and 70 ppb, respectively, at the time of consumption.
- The drinking water setback distances from functioning potable water intakes are provided in Table 1 (*DRINKING WATER SETBACK DISTANCES*).

**Table 1: Drinking Water Setback Distances**

Application concentration and minimum setback distance (ft) from functioning potable water intake			
≤ 1 ppm <sup>†</sup>	1.1 to 2.0 ppm <sup>†</sup>	2.1 to 3.0 ppm <sup>†</sup>	3.1 to 5 ppm <sup>†</sup>
600	1,200	1,800	2,400

<sup>†</sup> ppm acid equivalent target water concentration

- Following each application of Renovate MAX G, treated water must not be used for potable water unless **one** of the following restrictions has been observed:
  - A setback distance described in Table 1 was used for the application;
  - A waiting period of at least 21 days from the time of application has elapsed; or
  - An approved assay indicates that the triclopyr concentration is 400 ppb or less and the 2,4-D concentration is 70 ppb or less at the water intake. Sampling for drinking water analyses should occur no sooner than stated in Table 2. **NOTE:** Sampling for drinking water analysis should occur no sooner than 3 days after Renovate MAX G application. Analysis of 2,4-D in drinking water samples must be completed by a laboratory that is certified under the Safe Drinking Water Act to perform drinking water analysis using a currently approved version of analytical Method Number 515, 555, other methods for 2,4-D as may be listed in Title 40 CFR, Part 141.24, or Method Number 4015 (immunoassay of 2,4-D) from U.S. EPA Test Methods for Evaluating Solid Waste SW-846.

**Table 2: Sampling for Drinking Water Analyses<sup>†</sup>**

Minimum days after application before initial water sampling at the functioning potable water intake		
≤ 1 ppm <sup>††</sup>	1.1 to 3.0 ppm <sup>††</sup>	3.1 to 5.0 ppm <sup>††</sup>
5	10	14

<sup>†</sup> These are general guidelines; the amount of time required for residues to reach concentrations acceptable for drinking or irrigation will depend on the total acres treated relative to water body size, application rates, water exchange rates, weed density, and various other factors. Consult a SePRO Aquatic Specialist for site specific recommendations.

<sup>††</sup> ppm acid equivalent target water concentration

• **If no setback distance from Table 1 is to be used for the application, applicators or the authorizing organization must provide a drinking water notification and an advisory to shut off all potable water intakes inside the setback zone prior to Renovate MAX G application.** Notification to the party responsible for a public water supply or to individual private water users must be done in a manner to assure that the party is aware of the water use restrictions when this product is applied to potable water. The following is an example of a notification via posting, but other methods of notification which convey the above restrictions may be used and may be required in some cases under state or local law or as a condition of a permit.

**- Example:**

- Posting notification should be located every 250 feet including the shoreline of the treated area and up to 250 feet of shoreline past the application site to include immediate public access points. Posting should include the day and time of application. Posting may be removed if analyses of a sample collected at the intake, no sooner than stated in Table 2, shows that the triclopyr concentration in the water is 400 ppb or less and the 2,4-D concentration is 70 ppb or less, or after 21 days following application, whichever occurs first.

**- Text of notification:** Wait 21 days before diverting functioning surface water intakes from the treated aquatic site to use as drinking water unless water at functioning drinking water intakes is tested no sooner than [insert days from Table 2] and is demonstrated by assay to contain no more than 400 ppb triclopyr and 70 ppb 2,4-D. Application Date: \_\_\_\_\_, Time: \_\_\_\_\_.

• **NOTE:** Existing potable water intakes that are no longer in use, such as those replaced by a connection to a municipal water system or a potable water well, are not considered to be functioning potable water intakes.

• Drinking water setback distances do not apply to terrestrial applications of triclopyr or 2,4-D adjacent to water bodies with potable water intakes.

## GRAZING AND HAYING RESTRICTIONS

Except for lactating dairy animals, there are no grazing restrictions following application of this product.

• **Grazing Lactating Dairy Animals:** Do not allow lactating dairy animals to graze treated areas until the next growing season following application of this product.

• **Do not** harvest hay for 14 days after application.

• Grazed areas of sites may be spot treated if they comprise no more than 10% of the total grazable area.

## SLAUGHTER RESTRICTIONS

During the season of application, withdraw livestock from grazing treated grass at least 3 days before slaughter.

## DRIFT MANAGEMENT

A variety of factors including weather conditions (e.g., wind direction, wind speed, temperature, relative humidity) and method of application (e.g., ground, aerial, airblast) can influence pesticide drift. The applicator must evaluate all factors and make appropriate adjustments when applying this product. Applying Renovate MAX G through an enclosed eductor or slurry injection injection system via a continuous stream of water and/or injected under the water surface further minimizes drift potential.

### Wind Speed

Do not apply at wind speeds greater than 15 mph. Only apply this product if the wind direction favors on-target deposition and there are not sensitive areas (including, but not limited to, residential areas, bodies of water, known habitat for non-target species, non-target crops) near enough to be injured.

### Temperature Inversions

If applying at wind speeds less than 3 mph, the applicator must determine if: a) conditions of temperature inversion exist, or b) stable atmospheric conditions exist at or below application height. Do not make applications into areas of temperature inversions or stable atmospheric conditions.

**Susceptible Plants:** Do not apply under circumstances where drift may occur to food, forage, or other plantings that might be damaged or crops thereof rendered unfit for sale, use or consumption. Susceptible crops include, but are not limited to, cotton, okra, flowers, grapes (in growing stage), fruit trees (foliage), soybeans (vegetative stage), ornamentals, sunflowers, tomatoes, beans, and other vegetables, or tobacco. Small amounts of pesticide drift that might not be visible may injure susceptible broadleaf plants.

**Other State and Local Requirements:** Applicators must follow all state and local pesticide drift requirements regarding application of triclopyr or 2,4-D herbicides in aquatic sites. Where states have more stringent regulations, they must be observed.

### Equipment

All aerial and ground application equipment must be properly maintained and calibrated using appropriate carriers or surrogates.

### Aerial applications

• Apply Renovate MAX G at the lowest height consistent with efficacy and flight safety. Do not apply at a height greater than 10 feet above the water surface or plant canopy unless a greater height is required for aircraft safety.

• When applications are made with a crosswind, the swath will be displaced downwind. The applicator must compensate for this by adjusting the path of the aircraft upwind.

## AQUATIC WEEDS CONTROLLED BY RENOVATE MAX G

Efficacy and selectivity of Renovate MAX G is dependent upon dose, time of year, stage of growth, method of application, and water movement. The following categories—highly susceptible, moderately susceptible, and less susceptible—are provided to define species that may be controlled using Renovate MAX G.

Efficacy and selectivity is dependent on many factors, and can be managed through selection of application rates, application techniques and timing, etc. Rate selection will be partially dependent on characteristics of the treatment area. Consult with SePRO Corporation to determine best treatment protocols to manage individual species and to meet specific aquatic plant management objectives. Plants listed as moderately susceptible and less susceptible can be controlled under most use conditions, but generally require higher application rates.

### HIGHLY SUSCEPTIBLE VASCULAR AQUATIC PLANTS

Eurasian watermilfoil (*Myriophyllum spicatum*)  
 hybrid watermilfoil (*Myriophyllum spicatum x sibiricum*)

### MODERATELY SUSCEPTIBLE VASCULAR AQUATIC PLANTS

northern watermilfoil (*Myriophyllum sibiricum*)  
 other milfoil species (*Myriophyllum* spp.)  
 bladderwort (*Utricularia* spp.)  
 white water lily (*Nymphaea* spp.)  
 watershield (*Brasenia* spp.)

### LESS SUSCEPTIBLE VASCULAR AQUATIC PLANTS

variable-leaf milfoil (*Myriophyllum heterophyllum*)  
 water stargrass (*Heteranthera dubia*)  
 coontail (*Ceratophyllum demersum*)  
 parrotsfeather (*Myriophyllum aquaticum*)<sup>††</sup>  
 yellow water lily or spatterdock (*Nuphar* spp.)  
 water chestnut (*Trapa natans*)<sup>†,††</sup>

† Not for use in California

†† Retreatment may be needed to achieve desired level of control.

## Application Methods

### Surface Application

Use a mechanical spreader such as a fertilizer spreader, blower, mechanical seeder, an eductor system, or similar equipment capable of uniformly applying Renovate MAX G. Before spreading any product, carefully calibrate the application equipment. When using boats and power equipment, you must determine the proper combination of (1) boat speed, (2) rate of delivery from the spreader, and (3) width of swath covered by the granules.

Use the following formula to calibrate the spreader's delivery in pounds of Renovate MAX G per minute:

$$\text{Pounds per Minute} = \frac{\text{miles per hour} \times \text{swath width (feet)} \times \text{pounds per acre}}{495}$$

### Aerial Application (Helicopter Only)

Ensure uniform application. All equipment should be properly calibrated using blanks with similar physical characteristics to Renovate MAX G. To avoid streaked, uneven or overlapped application, use an appropriate tracking device (e.g. GPS). Refer to the *DRIFT MANAGEMENT* section of this label for additional precautions and instructions for aerial application.

### Floating-leaf and Emergent Weeds

For control of water lily's (*Nymphaea* spp. and *Nuphar* spp.), watershield (*Brasenia* spp.), and other susceptible emergent and floating-leaf herbaceous weeds, apply up to 1.0 to 5.0 ppm. Apply when plants are actively growing.

### Submersed Weeds

For control of Eurasian watermilfoil (*Myriophyllum spicatum*) and other submersed weeds, apply Renovate MAX G at concentrations up to 0.25 to 5.0 ppm in treated water. Rates should be selected according to the Table 3 (*CONCENTRATION OF RENOVATE MAX G IN WATER*). For optimal control, apply when Eurasian watermilfoil or other submersed weeds are actively growing.

When controlling Eurasian watermilfoil in plant communities containing other desirable susceptible species, selectivity may be enhanced generally by using a rate lower in the range, treatment timing, application technique, etc.; consult a SePRO Aquatic Specialist for site specific recommendations.

**Table 3: Concentration of Renovate MAX G in Water (ppm a.e.)<sup>†</sup>**

Average Water Depth (ft)	Pounds Renovate MAX G / Acre					
	0.25 ppm	0.5 ppm	1.0 ppm	2.0 ppm	4.0 ppm	5.0 ppm
1	4.7	9.4	18.8	37.5	75.0	93.7
2	9.4	18.8	37.5	75.0	150.0	187.5
3	14.1	28.1	56.3	112.5	225.0	281.2
4	18.8	37.5	75.0	150.0	300.0	375.0
5	23.4	46.9	93.8	187.5	375.0	468.7

<sup>†</sup>Use of higher rates in the rate range is necessary to achieve desired control in areas of greater water exchange; when treating more mature plants; when targeting more difficult to control aquatic species; and when treating small areas in larger bodies of water (spot treatments). Lower concentrations are generally used when conducting early season large-scale treatments; and treating larger areas, more immature plants, and areas with less potential for rapid water exchange. Some areas may require a repeat application to control re-growth.

The following formula can be used to calculate applications rates based on depths exceeding 4 feet deep or when using a concentration not in the Table 3.

**Pounds of Renovate MAX G per Acre = average depth x target ppm x 18.75**

### Example Calculation:

6 foot average depth x 1.25 ppm x 18.75 = 140.6 pounds of Renovate MAX G per acre

**NOTE:** apply a maximum of 93.7 pounds of Renovate MAX G (13.5 lbs a.e.)/acre-foot per application. Do not exceed 5.0 ppm during any single application.

### COMBINATIONS WITH OTHER HERBICIDES

Renovate MAX G may be combined or applied simultaneously with other herbicides to increase the weed control spectrum or enhance efficacy. Follow all applicable use directions, precautions, and restrictions on all labels used in the combination.

**IF ANY OF THE CONTENT OF THIS LABEL IS NOT UNDERSTOOD, OR YOU NEED FURTHER ASSISTANCE, CONTACT A SEPRO AQUATIC SPECIALIST WITH QUESTIONS SPECIFIC TO YOUR APPLICATION.**

**Storage and Disposal**

Do not contaminate water, food or feed by storage or disposal.

**Pesticide Storage:** Store in original container only. Do not store near feed or foodstuffs. In case of spill, contain material and dispose as waste.

**Pesticide Disposal:** Wastes resulting from use of this product may be used according to label directions or disposed of at an approved waste disposal facility.

**Nonrefillable Container Disposal (non-rigid, any size):**

Completely empty bag into application equipment. Then dispose of empty bag in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

## Terms and Conditions of Use

If terms of the following *Warranty Disclaimer*, *Inherent Risks of Use*, and *Limitation of Remedies* are not acceptable, return unopened package at once to the seller for a full refund of purchase price paid. Otherwise, use by the buyer or any other user constitutes acceptance of the terms under *Warranty Disclaimer*, *Inherent Risks of Use* and *Limitations of Remedies*.

## Warranty Disclaimer

SePRO Corporation warrants that the product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. **TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, SEPRO CORPORATION MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.**

## Inherent Risks of Use

It is impossible to eliminate all risks associated with use of this product. Plant injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label such as unfavorable temperatures, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner of application, or other factors, all of which are beyond the control of SePRO Corporation as the seller. To the extent consistent with applicable law, all such risks shall be assumed by buyer.

## Limitation of Remedies

To the extent consistent with applicable law, the exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability, or other legal theories) shall be limited to, at SePRO Corporation's election, one of the following:

- (1) Refund of purchase price paid by buyer or user for product bought, or
- (2) Replacement of amount of product used.

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