COMMONWEALTH of VIRGINIA

Management Plan for *Phragmites australis* on the Seaside of Virginia's Eastern Shore

Prepared by:
Virginia Department of Conservation and Recreation
Division of Natural Heritage

Prepared for:
United States Department of Commerce
National Oceanic and Atmospheric Administration
and
Virginia Department of Environmental Quality
Coastal Zone Management Program
Seaside Heritage Program – Year 6

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By:
VIRGINIA DEPARTMENT OF CONSERVATION AND RECREATION
DIVISION OF NATURAL HERITAGE

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INTRODUCTION

For the past century, Phragmites has increased in abundance and distribution throughout wetlands in the United States particularly along the Atlantic coast. An introduced invasive subspecies is now known to be the cause of the current rapid invasion (Saltonstall 2002). The high recent rate of Phragmites spread has probably been assisted by human-induced substrate disturbance, changes to water flow, and increased nutrient availability (Chambers et al. 1999). Phragmites infestations have resulted in decreased wildlife habitat, altered hydrological regimes, increased wildland fire hazard, decreased functioning of drainage ditches, reduced growth of commercial pine stands on wet sites, and devaluation of real estate due to viewshed obstruction (Thompson 2004; Myers et al. 2007). Because Phragmites tolerates a wide range of habitats, it is found in a number of different settings, such as waterfront lawn edges, wet forests, and open marsh.

Because Phragmites is already so widespread and well established on the Eastern Shore, and as it is difficult and expensive to control, eradication of this species is not a realistic management option. A more realistic goal is to reduce and maintain Phragmites to a reasonably low level of abundance. Without management actions to control Phragmites, this aggressive species rapidly takes over and occupies all available habitat niches, including shorelines and wetlands. This has already happened in many parts of the northern mid-Atlantic region.

This management plan provides 1) information on Phragmites biology, ecology, distribution and threats to natural resources; 2) broad goals for Phragmites management; 3) management strategies for controlling the spread of Phragmites in a regional setting such as the Eastern Shore of Virginia; and 4) management guidelines and recommendations for specific settings on the Eastern Shore Seaside.

PHRAGMITES LIFE HISTORY, DISTRIBUTION, AND THREATS

Native and Invasive Phragmites

The tall wetland grass known as "Phragmites" (*Phragmites australis*) and also known as "common reed" occurs in Virginia as two subspecies. *Phragmites australis* ssp. *americanus* is considered native to North America (Saltonstall 2005). A non-native, invasive subspecies, *Phragmites australis* ssp. *australis*, is believed to have been introduced from Europe, Asia, and/or Africa (Saltonstall 2002). The introduced Phragmites is one of the most serious and problematic invasive plant species in North America (Marks et al. 1993; Norris et al. 2002).

The native subspecies of Phragmites is uncommon to relatively rare in Virginia, appearing on DCR's watchlist of rare plants (Townsend 2007). A field study conducted in 2005 with the purpose of determining the abundance of native Phragmites on the Seaside of Virginia's Eastern Shore found no native stands present (Myers et al. 2005). Native Phragmites produces a shorter stem, yellow-green leaves, and tends to be found in undisturbed marshes with fresh to slightly brackish water. In this management plan, "Phragmites" refers to the introduced invasive subspecies while "native Phragmites" refers to the native subspecies. Appendix A provides a description of the key differences between the two subspecies of Phragmites.

Description

Invasive, non-native Phragmites grows to 15 feet in height and forms thick monotypic stands. Bluish-green leaves are 1-1.5 inches wide and up to 20 inches long and leaves are alternate along the stem (Radford et al. 1968). The dense, oval-shaped, flowering plume is purple-red. As the flowers mature, the plume becomes golden brown with a "fluffy" appearance (Figures 1 and 2). A thick network of roots and rhizomes supports the stiff bamboo-like stems (Saltonstall 2005).

Figure 1. Invasive Phragmites in bloom.

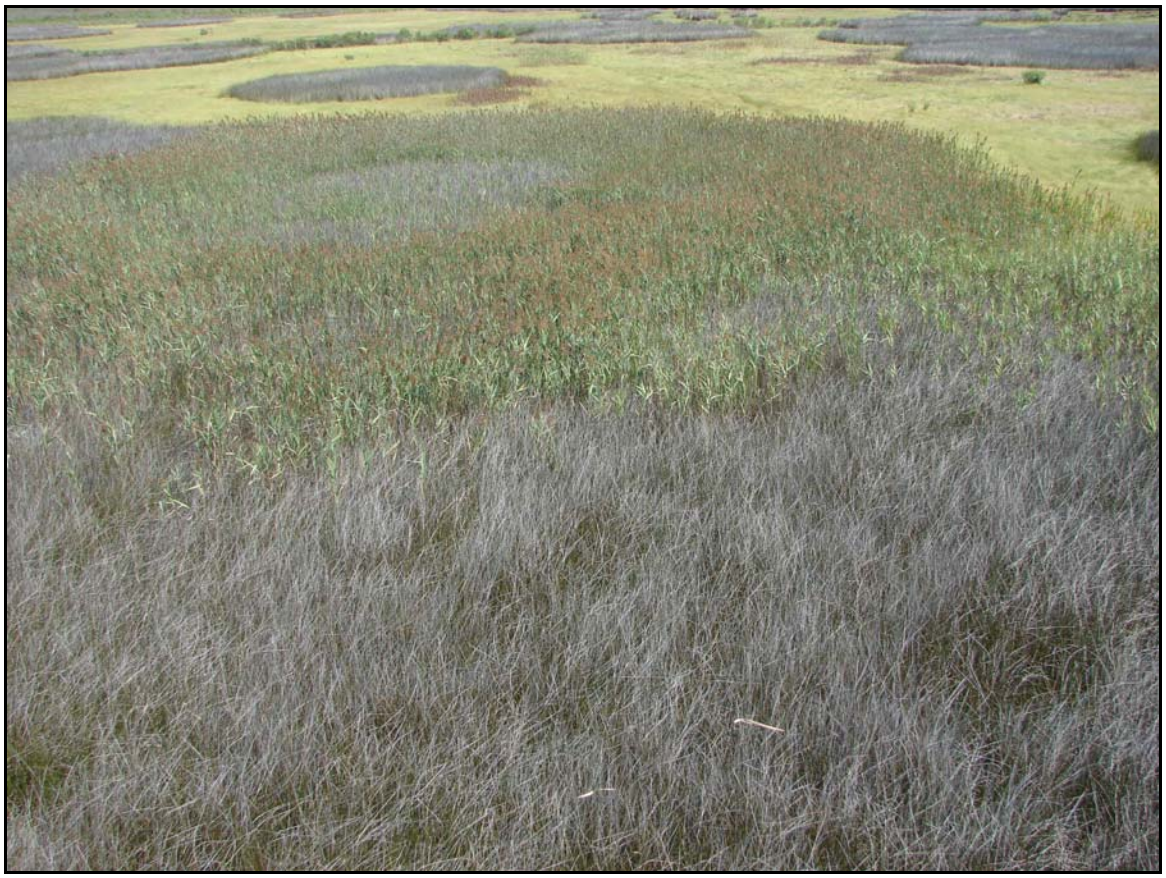

Figure 2. Non-native Phragmites invading black needlerush marsh. Phragmites is the green vegetation in the center; black needlerush is in the foreground.

Life History

Phragmites is a long-lived perennial and spreads rapidly due to its ability to reproduce both by seed and vegetatively by rhizome fragments, establishing readily in disturbed areas. Flowering takes place in July and August. Rhizomes grow several feet deep and stolons can grow horizontally 10 feet or more per year. Disturbances, such as dredging and placing spoil, exposing mineral soil, and fire and storm-related disturbances heighten both the risk and rate of Phragmites colonization and/or spread (Marks et al. 1993).

Habitat Requirements and Constraints

Phragmites is found in tidal and nontidal brackish and freshwater marshes. On the Seaside of the Eastern Shore, it appears most frequently at the marsh-upland interface, above the mean high-tide line (Figure 3). It does not occur in frequently and deeply flooded polyhaline (18 to 30 ppt) salt marsh except on raised islands and dredge spoil sites. One study found that invasion by Phragmites is limited to marsh sites where salinity is <10%, sulfide concentrations are less than 0.1 mM, and flooding frequency is less than 10% (Chambers et al. 2003). Phragmites is also found on river edges and shores of lakes and ponds, in roadside and agricultural ditches, and on wet edges of agricultural fields.

Figure 3. Phragmites often dominates the marsh-upland interface on the Virginia Eastern Shore Seaside.

Distribution

Phragmites is found in every U.S. state and is well-established and increasing in coastal habitats of Virginia (Myers et al. 2004). The Virginia portion of the Chesapeake Bay and the extensive estuarine and island wetlands of the Eastern Shore are currently experiencing high rates of invasion by non-native Phragmites. In 2004, DCR conducted an aerial census and GPS mapping of Phragmites on the Seaside, including the barrier islands, from Fisherman's Island to Chincoteague (Myers et al. 2004). The survey found a total of 2,024 acres of Phragmites, occurring in 1,365 separate patches (Figures 4 and 5). Average patch size was 1.4 acres. Many (698) small patches ($\leq$ 0.25 acre) occurred throughout the survey area. In 2008, DCR repeated the aerial census on the Seaside and found a total of 2,145 acres of Phragmites occurring in 2,251 separate patches. Small patches ($\leq$ 0.25 acre) totaled 1,172, or 68% more small sized patches than were found in 2004.

Interactive map views of Eastern Shore Seaside Phragmites patch locations may be accessed through DCR's web-based Virginia Phragmites Mapping Tool at: http://128.172.160.130/phrag/ (Figure 6).

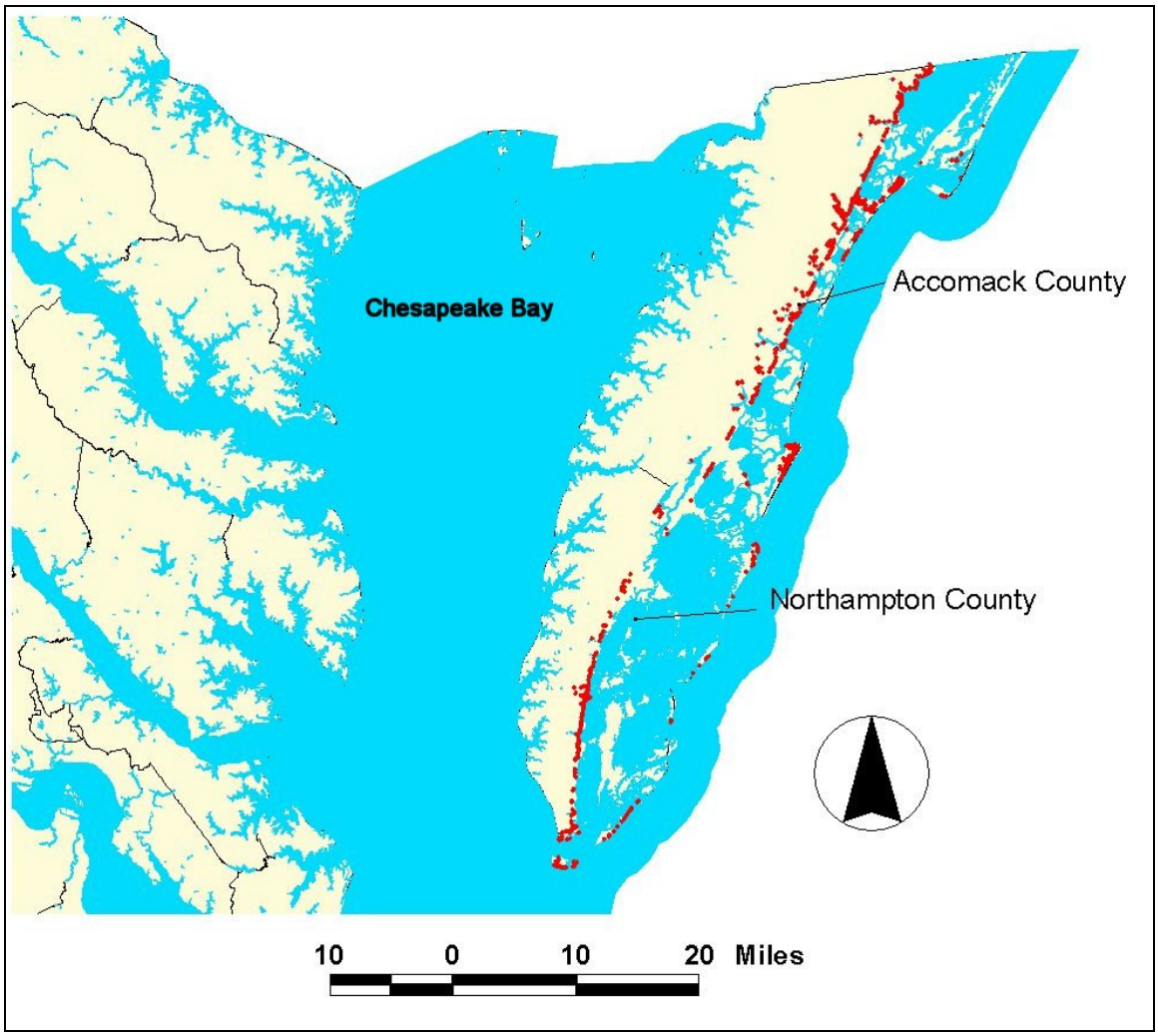

Figure 4. Eastern Shore of Virginia showing 2004 Phragmites aerial census data. Phragmites patch occurrences are shown in red.

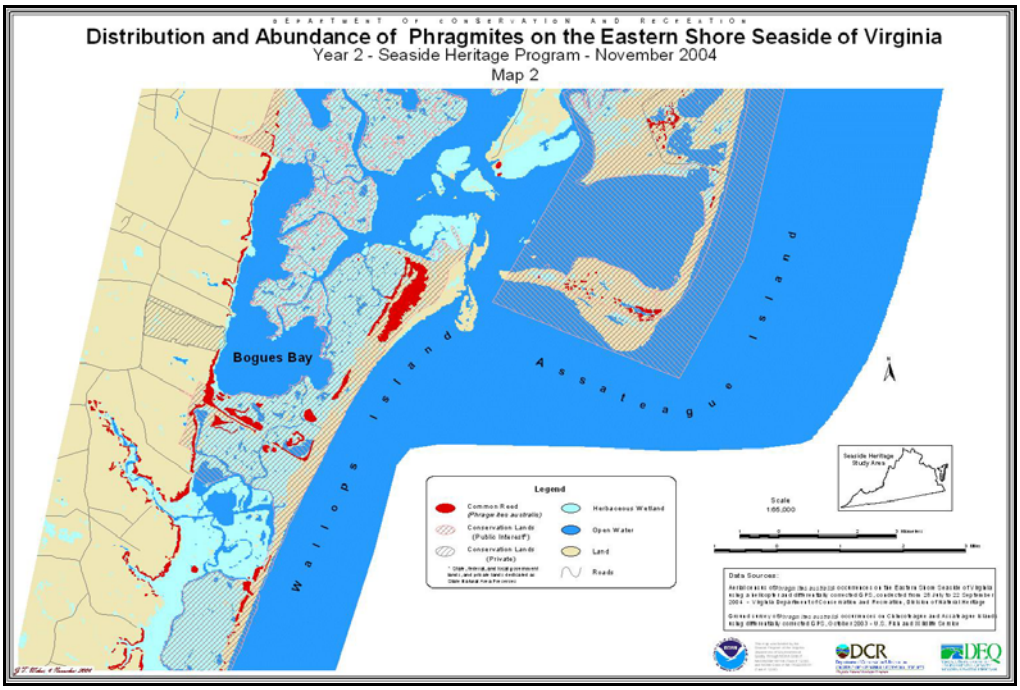

Figure 5. Mapped occurrences of Phragmites (red patches) documented by the 2004 aerial census of the Eastern Shore Seaside.

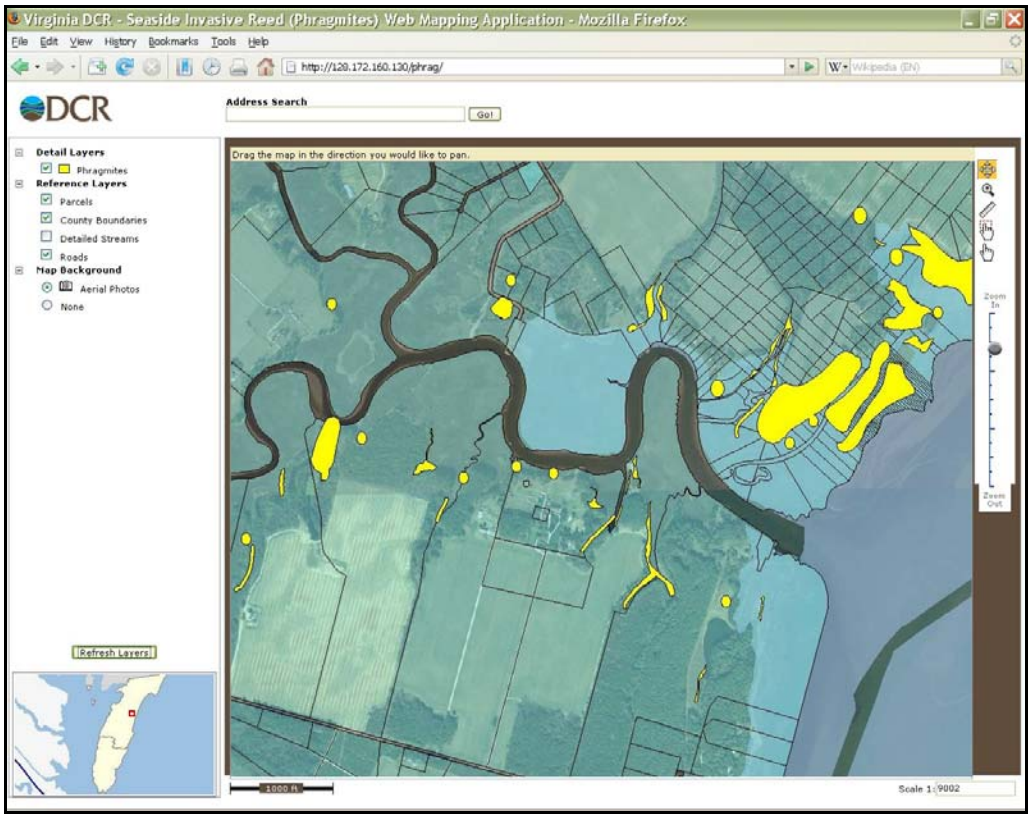

Figure 6. Virginia Phragmites Mapping Tool website. Phragmites patches are shown in yellow.

Threats

Loss of native plant and wildlife habitat. The invasive form of Phragmites reduces biological diversity in marshes by forming dense stands and crowding out native plants and the wildlife that depend on them (Marks et al. 1993; Saltonstall 2005). Phragmites is a strong competitor, in part, due to its ability to release gallic acid into the soil, destroying the roots of other plant species. Gallic acid persists in the soil and inhibits other plants from becoming established (Rudrappa et al. 2007). Vast areas of marsh have been invaded by Phragmites in New Jersey, Delaware, and Maryland. A recent study on the Seaside found that avian marsh species rarely use Phragmites stands (Paxton 2007). Upland migratory songbird habitat is also threatened by an increase in fire hazard from adjacent Phragmites infestations.

Natural heritage resources at risk. Natural heritage resources are defined in the Code of Virginia (Natural Area Preserves Act) as "the habitat of rare, threatened, or endangered plant and animal species, rare or state significant natural communities or geologic sites, and similar features of scientific interest benefiting the welfare of the citizens of the Commonwealth".

Phragmites threatens the habitat of 29 rare plant species, 22 rare animal species, and nine rare vegetation communities on the Eastern Shore Seaside. Many of these species are listed under federal and state endangered species acts. Wilson's Plover (*Charadrius wilsonia*) is both federally and state listed as endangered. Three species are federally and state listed threatened: seabeach amaranth (*Amaranthus pumilus*), Gull-billed Tern (*Sterna niloctica*), and Piping Plover (*Charadrius melodus*). Ten bird species are listed as Species of Concern: Great Egret (*Anas alba*), Northern Harrier (*Circus cyaneus*), Little Blue Heron (*Egretta caerulea*), Tricolored Heron (*Egretta tricolor*), Yellow-crowned Night Heron (*Nyctanassa violacea*), Brown Pelican (*Pelecanus occidentalis*), Glossy Ibis (*Plegadis falcinellus*), Least Tern (*Sterna antillarum*), Caspian Tern (*Sterna caspia*), and Sandwich Tern (*Sterna sandvicensis*). Plant communities that provide the required composition and structure to support colonial bird nesting areas and landbird migration concentration areas are also threatened by Phragmites (Table 1).

Table 1. Natural heritage resources threatened by Phragmites on the Virginia Eastern Shore. (Source of ranks: Townsend 2007 and Roble 2006).

SCIENTIFIC NAME	COMMON NAME	GRANK	SRANK	FEDSTAT	SPROT
PLANTS					
Amaranthus pumilus	Seabeach Amaranth	G2	S1	LT	LT
Carex lupuliformis	False Hop Sedge	G4	S2		
Carex silicea	Sea-beach Sedge	G5	S1		
Chamaesyce bombensis	Southern Beach Spurge	G4	S2		
Cladium jamaicense	Sawgrass	T5	S2		
Cuscuta coryli	Hazel Dodder	G5	S2?		
Cuscuta polygonorum	Smartweed Dodder	G5	S2?		
Cyperus diandrus	Umbrella Flatsedge	G5	S1		
Dichanthelium ovale var. ovale	Oval-fruited Panic Grass	T5	S1?		
Eleocharis halophila	Salt-marsh Spikerush	G4	S1		
Erigeron vernus	White-top Fleabane	G5	S2		
Helianthemum propinquum	Low Frostweed	G4	S1		
Heliotropium curassavicum	Seaside Heliotrope	G5	S1		
Hydrocotyle bonariensis	Coastal-plain Penny-wort	G5	S1?		
Juncus megacephalus	Big-head Rush	G4	S2		
Juncus pelocarpus	Brown-fruited Rush	G5	S1		
Kalmia angustifolia	Sheep-laurel	G5	S2		
Paspalum distichum	Joint Paspalum	G5	S2		
Physalis walteri	Sticky Ground-cherry	G4	S2		
Polygonum glaucum	Sea-beach Knotweed	G3	S1S2		
Rhynchospora alba	White Beakrush	G5	S2		
Rhynchospora oligantha	Few-flowered Beakrush	G4	S1		
Sabatia campanulata	Slender Marsh Pink	G5	S2		
Scleria verticillata	Whorled Nutrush	G5	S2		
Sclerolepis uniflora	One-flower Sclerolepis	G4	S1		
Solidago latissimifolia	Elliott Goldenrod	G5	S2		
Thelypteris simulata	Bog Fern	G4	S1S2		
Utricularia juncea	Southern Bladderwort	G5	S2		
Vaccinium macrocarpon	Large Cranberry	G4	S2		
ANIMALS					
Anas strepera	Gadwall	G5	S2B,S3N		
Ardea alba	Great Egret	G5	S2S3B,S3N		SC
Charadrius melodus	Piping Plover	G3	S2B,S1N	LT	LT
Charadrius wilsonia	Wilson's Plover	G5	S1B		LE
Cicindela lepida	Spectral Tiger Beetle	G3	S1		
Circus cyaneus	Northern Harrier	G5	S1S2B, S3N		SC
Cordulegaster diastatops	Delta-spotted Spiketail	G5	S1		
Egretta caerulea	Little Blue Heron	G5	S2B,S3N		SC
Egretta thula	Snowy Egret	G5	S2B,S3N		
Egretta tricolor	Tricolored Heron	G5	S2B,S3N		SC
Eudocimus albus	White Ibis	G5	S1B		
Himantopus mexicanus	Black-necked Stilt	G5	S1B		

SCIENTIFIC NAME	COMMON NAME	GRANK	SRANK	FEDSTAT	SPROT
Laterallus jamaicensis	Black Rail	G4	S2B,S2N		
Nyctanassa violacea	Yellow-crowned Night-heron	G5	S2S3B,S3N		SC
Pelecanus occidentalis	Brown Pelican	G4	S2B,S3N		SC
Plegadis falcinellus	Glossy Ibis	G5	S2B,S1N		SC
Rynchops niger	Black Skimmer	G5	S2B,S1N		
Sterna antillarum	Least Tern	G4	S2B		SC
Sterna caspia	Caspian Tern	G5	S1B,S2N		SC
Sterna maxima	Royal Tern	G5	S2B		
Sterna nilotica	Gull-billed Tern	G5	S2B		LT
Sterna sandvicensis	Sandwich Tern	G5	S1B		SC
COMMUNITIES					
VEGETATION COMMUNITIES					
Sea Level Fen		GNR	S1		
Maritime Dune Grassland		GNR	SNR		
Maritime Wet Pine Forest		GNR	SNR		
Interdune Pond		GNR	SNR		
Maritime Wet Grassland		GNR	SNR		
Coastal Plain / Piedmont Seepage Bog		GNR	SNR		
Tidal Oligohaline Marsh		GNR	SNR		
Tidal Mesohaline / Polyhaline Marsh		GNR	SNR		
Upper Beach / Overwash Flat		GNR	SNR		
ANIMAL COMMUNITIES					
Landbird Migratory Concentration Area		G3	S1		
Bird nesting colony		G5	SNR		

Conservation lands at risk. Of the 2,024 acres of Phragmites mapped on the Seaside in 2004, 1,146 acres were on lands owned by government agencies or private conservation organizations (Myers et al. 2005). Two entities, the USFWS and TNC own most of the lands supporting this considerable area of Phragmites (Table 2). Phragmites on these lands threatens the conservation values for which the properties are owned and managed. Both USFWS and TNC recognize this threat and have active Phragmites control programs. Coordinated management actions between DCR, USFWS, and TNC have formed a key component of the Seaside Heritage Program approach to Phragmites management (Table 2).

Table 2. Abundance of Phragmites on protected conservation lands in 2004 on the Eastern Shore Seaside.

Landowner	**Phragmites area (acres)**
U.S. Fish and Wildlife Service	583
The Nature Conservancy	417
State Agencies	58
Other	88
TOTAL	**1,146**

Increased fire hazard. Phragmites can increase the potential for damaging wildfires due to the large amount of dead standing vegetation and lowering of water tables. The woody stems of Phragmites die annually but persist for several years. New stems grow each year. Fires in a stand of Phragmites can cause spot fires more than 100 feet from the origin of wind-born firebrands (Marks et al. 1993). Increased fire hazard threatens migratory songbird habitat, commercial pine stands, and residential properties.

Viewshed obstruction. Tall dense Phragmites patches degrade views of natural marshes and waterways by creating a dense visual barrier up to 15 feet in height.

Drainage ditches. Phragmites infestations cause decreased functioning of drainage ditches due to resulting biomass accumulation.

Degradation of commercial timberlands. Phragmites is increasingly invading wet pine stands, particularly after harvesting operations and in near-coastal areas subject to the effects of sea level rise. Phragmites easily out-competes planted pine seedlings and saplings, causing economic losses for landowners and adding additional management costs to timber rotations.

Recent Seaside Phragmites Control Actions

From 2005 through 2008 concerted efforts were made on the Eastern Shore to combat the Seaside Phragmites invasion. DCR treated 633 acres of Phragmites with funding provided by NOAA through the VCZMP-administered Seaside Heritage Program (SHP). All treatments were applied on lands held in the public interest and supporting natural heritage resources.

2005. DCR treated 225 acres of Phragmites at three state natural area preserves with the imazapyr-based herbicide, Habitat® during August and September of 2005. Sites treated were Parramore Island (220 acres), Wreck Island (one acre), and Mutton Hunk Fen (four acres).

2006. DCR treated 148 acres of Phragmites on the Seaside using Habitat® herbicide during August and September 2006. In August, DCR staff used ground-based equipment to treat approximately two acres of Phragmites at Wreck Island. Three sites were treated in September using a contracted aerial applicator: Wallops Island (92 acres); Parramore Island (40 acres), and Mockhorn Island (14 acres).

2007. DCR treated 150 acres of Phragmites at Wallops Island National Wildlife Refuge under SHP. Another 150 acres were treated on a combination of public and private lands with funding provided by the Wildlife Habitat Incentives Program (WHIP) under the 2002 Farm Bill and through a grant provided by the BASF, Inc. All 300 acres in 2007 was treated with Habitat® herbicide.

2008. Supported by SHP funds, DCR treated 112 acres of Phragmites in 2008 at Wallops Island National Wildlife Refuge (80 acres) and at Parramore Island (32 acres). Another 100 acres was treated on a combination of public and private lands with funding support from WHIP. All 212 acres treated on the Seaside in 2008 was with EcoImazapyr® herbicide.

In addition to DCR-led control projects listed above, the USFWS and TNC have implemented extensive Phragmites control actions on National Wildlife Refuges (NWR) and TNC Preserves, respectively. During the period 2005 to 2008, USFWS treated 580 acres of Phragmites at Chincoteague, Fisherman's Island, and Eastern Shore of Virginia NWRs, while TNC treated 605 acres at various locations on the Seaside. Other private landowners in Northampton County are known to have treated at least 90 acres of Phragmites over two successive years along the Mockhorn Bay mainland shoreline.

Overall, Phragmites treatments were applied on at least 2,160 acres of the Eastern Shore Seaside during the four years from 2005 to 2008, with some areas treated multiple times. While this is not a complete accounting of all Phragmites control actions during this time period, it is an indication that many Seaside landowners are aware of and attempting to do something about the Phragmites invasion in this resource-rich region of Virginia.

STRATEGIES FOR CONTROLLING PHRAGMITES

Because Phragmites is so widespread and well-established, eradication from the Eastern Shore is not a realistic management goal. Rather, management of Phragmites is more reasonably directed toward reducing the rate of spread and controlling Phragmites where it directly threatens high priority natural resources, property values, and public health. To achieve these goals, coastal landowners need to understand the threat of Phragmites and be encouraged to participate in early detection and rapid response control programs.

Goals and Objectives

The following are broadly stated goals under which management actions to control Phragmites can be conducted.

Goal 1. Maintain diverse, functional tidal marsh systems and the many values they provide.

Goal 2. Stop or reduce the rate of Phragmites spread into un-invaded wetlands and shorelines.

Goal 3. Prevent the otherwise inevitable colonization by Phragmites throughout Virginia's marsh systems and shorelines.

The following are specific objectives that suggest a prioritized approach for managing Phragmites within a regional context.

Objective 1. Control Phragmites at selected sites that support high-priority natural resources.

Objective 2. Control large patches of Phragmites that are a source of propagules (rhizome fragments and seeds) contributing to high inoculation rates and the establishment of new patches elsewhere on the Seaside.

Objective 3. Implement an effective public education and awareness program that will encourage support and participation for Phragmites management.

Management Strategies

Strategies are measurable actions aimed at achieving stated goals and objectives. The following strategies have been developed to help achieve the goals and objectives stated for the Eastern Shore.

Strategy 1 – Control and monitoring to protect natural heritage resources. DCR and TNC will conduct long-term control and monitoring of Phragmites invasions that threaten or are invading the habitat of rare species, natural communities, and significant natural areas.

Strategy 2 – Control and monitoring to protect wildlife habitat. USFWS will conduct long-term control and monitoring of Phragmites invasions that threaten migratory waterfowl, wading bird, and shore bird habitats as well as other priority wildlife habitats on the Eastern Shore.

Strategy 3 – Control and monitoring to protect public health and safety. Local governments will conduct control and monitoring of Phragmites that impacts public health (mosquito control) and surface water drainage management.

Strategy 4 – Control and monitoring to protect economic property values. Private landowners will control and monitor Phragmites that is impacting private land values such as farming, forestry, vacation homes, tourism, and real estate.

Strategy 5 – Partnering and resource pooling. Landowners should partner with other landowners with Phragmites infestations and pool resources to bring down management costs. This approach has been successfully demonstrated by the Rappahannock Phragmites Action Committee, a group founded by private citizens in partnership with federal and state land managers and private conservation organizations (Appendix F).

Strategy 6 – Education and technical assistance. DCR and other natural resource managers will continue to conduct Phragmites Control Workshops and distribute technical information to landowners and local governments in order to increase public awareness and understanding of the threats posed by Phragmites.

Strategy 7 – Monitoring Phragmites abundance and data sharing. DCR will continue to update and maintain the Virginia Phragmites mapping tool so that all landowners and managers will have access to current information about the abundance and distribution of Phragmites on the Eastern Shore. This information will facilitate control projects to reduce Phragmites occurrences.

Strategy 8 – Support of biological control research. All parties with a stake in Phragmites control will stay aware of and, to the extent possible, support research efforts to develop a safe and effective biological control mechanism that would eliminate or greatly reduce the threat from invasive, non-native Phragmites. Such a development could make obsolete the necessity of repeatedly applying chemicals to stands of marsh vegetation in perpetuity.

Strategy 9 – Financial assistance. Sources of financial assistance to landowners will be publicized. Landowners can form partnerships and develop large control projects that qualify for support under the WHIP (Wildlife Habitat Incentives Program). Current (2009) reimbursement rates are up to $270/acre for approved WHIP contracts for Phragmites control on private lands.

Strategy 10 – Virginia Phragmites Managers Working Group. DCR will continue to coordinate a statewide Phragmites Working Group. Eastern Shore landowners and managers can participate in order to stay abreast of advances in Phragmites control technology and to share information with peers and colleagues on an annual basis.

METHODS FOR CONTROLLING PHRAGMITES

Phragmites Control Considerations

Identification. Landowners and managers should confirm the identification of Phragmites before attempting control. Once the presence of Phragmites is confirmed, it should also be determined if it is the native or non-native invasive subspecies. While no native Phragmites has been confirmed on Virginia's Eastern Shore Seaside, the possibility remains that some stands could be present near the headwaters of tidal tributaries. Some native Phragmites has been reported to occur on the Eastern Shore Bayside in the Pocomoke River watershed; however, these sightings have not been confirmed (Heffernan, pers. obs. 2007).

Determining extent of infestation. Once the presence of invasive Phragmites has been confirmed, an estimate of the size of the infestation needs to be determined. One means of accomplishing this is to use the Virginia Phragmites Mapping Tool (VPMA), available on the internet at the following web address: http://128.172.160.130/phrag/. This tool currently displays 2004 Seaside, 2007 Bayside, and 2007 Rappahannock River Phragmites distribution data along with aerial photography, roads, and tax parcel boundaries. An online Help Tool will assist users with determining the area of Phragmites on an individual tract of land. New data from the 2008 Seaside Phragmites census will be added to the VPMA in summer 2009.

Establish management priorities. For large areas or numerous patches that cannot all be controlled in the same year, criteria need to be identified that determine which patches are the highest priority and should receive treatment first. Landowner objectives, ownership patterns, and urgency of threat are examples of criteria that can be used to help determine treatment priorities.

Choosing a treatment method. The abundance and location of Phragmites on a property generally determines which management options are appropriate. Most patches will need to be treated with herbicide. In situations where patches are very small or are accessible to vehicles and equipment, alternative methods such as physical removal or mowing may be possible.

Timing the treatment. Timing is important for all treatment options. The two herbicides recommended have different timing recommendations. See the herbicide section for details. Mowing must be done during the growing season before seed set. Failure to properly time treatments can result in wasted time and money.

Mowing

In situations where equipment can be safely operated, repeated mowing may be effective at controlling small patches of Phragmites. This treatment will require several years of repeatedly cutting back Phragmites stems. Mowing controls Phragmites by exhausting root/rhizome stored energy reserves and limiting the plant's ability to produce new energy via photosynthesis. The optimal time for cutting is soon after flowering, but before seed set. On the Eastern Shore, this is usually late July and early August. This approach can work where the stand meets the following criteria.

- The stand is readily accessible to personnel and mowing equipment – whether a hand-held hedge trimmer / brush cutter or a tractor equipped with specialized marsh mowing equipment.

- The stand is cut before seed set.

- The cut stems are removed from where they could take roots and re-infest the treatment area.

- Cutting can be maintained without fail every year for several consecutive years until the plant's energy reserves are finally depleted, and the roots / rhizomes fail to send up new shoots.

Small stands – perhaps up to 1/2 acre – may be cut using hand-held power hedge trimmers or brush cutters. Larger areas generally require mowing equipment appropriate to the site conditions. A tractor may be suitable for lawns, agricultural fields, and some harvested commercial forest lands. A four-wheel drive compact tractor equipped with wide (high flotation) tires and a rotary mower may be used on wetter soils.

Mowing is most effective when combined with herbicide treatments. A stand of Phragmites may be cut before or during flowering and allowed to resprout. Herbicide should then be applied to resprouting plants once leaves are open and plants are from two to four feet tall. Mowing facilitates herbicide application when using backpack sprayer by reducing plant height and leaf area. Mowing also weakens plants by forcing them to use stored energy reserves for resprouting.

Herbicides
Until 2003, Phragmites was treated almost entirely using glyphosate-based herbicides (Norris et al. 2002). Glyphosate requires carefully timed and annually repeated treatments, usually for two to three years, to achieve desired control. A new product with the active ingredient imazapyr, Habitat® was approved for wetland use in 2003 and has now come into common use for controlling Phragmites. Experience to date on the use of Habitat® suggests that it provides somewhat improved control over glyphosate; however, it still requires follow-up applications following the first treatment. The effective application window for imazapyr is wider than for glyphosate. Glyphosate is recommended for use during the late growing season. Imazapyr can be applied earlier during the growing season, giving managers more flexibility in planning and executing control treatments.

Glyphosate. Glyphosate is the active ingredient in the familiar herbicide, Round-up®. However, only EPA-approved wetland formulations of glyphosate such as Rodeo® or Aqua Neat® are legal to use to treat Phragmites. Glyphosate is toxic to woody and herbaceous plants as it acts to inhibit the synthesis of proteins by plant cells. Note that effects on the target may be slow to become apparent. Glyphosate is broken up in the environment by microbes. It readily attaches to soil particles and loses its toxicity to plants and its ability to move through the environment. Its half-life averages at two months. Glyphosate is harmless to animals, but some formulations contain surfactants (adjuvants) that are toxic to aquatic organisms (Tu et al. 2001).

Imazapyr. Imazapyr is a non-selective herbicide used to control grasses, broadleaf herbaceous plants, and woody species and now approved by the EPA for controlling invasive plants including Phragmites in wetlands. Product names include Habitat® (BASF, Inc.) and EcoImazapyr®. Imazapyr inhibits the synthesis of broad-chained amino acids, which are only found in plants. Note that it may take several weeks following treatment for effects on the target species to become apparent. Imazapyr is degraded in soils by microbial breakdown and average half-life in soils ranges from one to five months. When exposed to sunlight in a water column, half-life may be as low as one to two days. Testing of imazapyr has shown very low toxicity to birds and mammals, and it does not affect algae or submersed vegetation (Patten 2003; Entrix 2003; Pless 2005); however, it can cause severe eye damage (Tu et al. 2001).

Label instructions. Always follow label instructions when using herbicides. Labels provide appropriate mixing rates and adjuvants for specific situations. Safety guidelines and emergency information are also found on the label (Appendix B and C). *It is a violation of federal law to apply herbicides in a manner that is inconsistent with label instructions.*

Adjuvants. The Weed Science Society of America defines an adjuvant as "any substance in an herbicide formulation or added to the spray tank to modify herbicidal activity or application characteristics" (Hanzen 2000). An adjuvant may facilitate mixing, application, or effectiveness of an herbicide (Tu et al. 2001). Effectiveness is increased as adjuvants are "sticky" and reduce the tendency for the herbicide to roll off the leaf. An adjuvant may also help spread an herbicide over the entire surface area of a leaf, therefore bringing more chemical in contact with plant tissue and ensuring its uptake. Adjuvants can also increase the ability of a chemical to penetrate plant tissue. Yet another type of adjuvant is colorant or dye, which is sometimes added to herbicide mixtures to allow an applicator to see where herbicide has already been applied.

Adjuvants are chemically active and some may move from their target and act as a pollutant. In some cases, they may be more toxic than the herbicide with which they are mixed. Therefore, care should be given to selecting the proper adjuvant for each spray situation. Herbicide labels provide information on recommended adjuvants for specific application methods and situations.

Herbicide Application Methods

Descriptions of herbicide application methods to control Phragmites are limited here to ground-based and aerial foliar spray techniques.

Ground-based application. Ground-based methods use spray equipment ranging from hand-held squirt bottles, to backpack sprayers, to gas-powered sprayers and large volume tanks mounted on vehicles, such as trucks, boats, or amphibious tracked vehicles.

As a rule-of-thumb, backpack sprayer application is feasible for relatively small patches of Phragmites up to $1/10^{th}$ acre (about 4300 square feet, or an area 66 by 66 feet). Larger patches may be treated with a backpack sprayer over a period of several days, or in stages over several years. Adding an adjuvant dye to the herbicide mixture will aid the applicator in keeping track of where spray has been applied.

Hiring a professional pesticide applicator specializing in ground-based control of invasive plants should be considered for Phragmites patches between 1/10th and five acres. Attempting herbicide control for a Phragmites patch covering an acre of marsh is a tall order for any landowner. Consider using a pro (Appendix D).

Personal protective equipment (PPE) should always be used when handling and using herbicides. PPE include long sleeve shirt, chemical resistant gloves, shoes and socks. Eye protection should also be used, in particular when using herbicides containing imazapyr. Chemicals should be mixed in an open, well-ventilated area and breathing the spray mist should be avoided.

Aerial application. For Phragmites patches covering over five acres or for controlling numerous small patches, aerial application is likely to be the most efficient and economical control method. Generally, if the total area of Phragmites to be treated is over five acres, landowners should compare costs of ground-based and aerial application. Landowners should consider joining forces to coordinate control actions. Developing a single contract to treat multiple ownerships will bring per acre costs of aerial application down.

Aerial application involves a helicopter mounted with a spray boom and herbicide tank. The helicopter is accompanied by tank truck carrying fuel and herbicide. The helicopter flies low and slow over a target area to provide thorough coverage with herbicide and ensure a minimum of spray drift to non-target areas. Aerial application can treat areas that would be difficult or impossible to treat using ground-based methods. Aerial methods also provide an alternative where ground application would cause unwanted soil disturbance, such as in open marsh. For a list of aerial contractors see Appendix D.

Fire

The use of fire alone is not an effective treatment to control Phragmites and will actually benefits its growth. However, fire in combination with herbicide treatments can help to control Phragmites and assist native plant colonization (Marks et al. 1993). By removing dead stems, fire increases the effectiveness of the next herbicide treatment by removing a physical spray obstruction. Burning the dead standing Phragmites stems between herbicide treatments speeds recovery of native marsh vegetation by reducing shade, exposing soil, and releasing nutrients bound up in Phragmites stems. However, landowners should not attempt to burn Phragmites patches unless they have extensive training and experience in fire management and have the equipment and other resources necessary to plan and control their prescribed fires. Most landowners should not use fire for Phragmites control unless they contract with certified professional fire management providers.

Herbicides combined with fire. A successful herbicide treatment will result in a stand of dead Phragmites stems in addition to the thick rhizome mat. With little bare soil, native plant species are slow to reestablish, and may take two growing seasons or more to re-colonize following treatment (Farnsworth and Myerson 1999; McCauley, pers. comm. 2007). Burning the site in the winter or early spring following the initial herbicide treatment will facilitate native plant establishment (Marks et al. 1993). It is important to re-apply herbicide to any and all Phragmites sprouts that return in the growing season following the prescribed burn. *Failure to do so is almost certain to result in near-complete re-colonization of the original Phragmites stand.*

Remember that burning, alone, will not control Phragmites and in fact will increase its vigor (Marks et al. 1993).

Flooding

In situations where water levels can be manipulated (ponds, ditches, impounded marshes), flooding can be an effective treatment to control Phragmites. To be effective, rhizomes must be flooded with at least three feet of water for four months during the growing season. Cutting combined with flooding may also kill Phragmites (Marks et al. 1993).

Biological Control

Research into four moth species of the genus *Archanara* for use as biological control agents is currently underway at Cornell University (Blossey et al. 2006). Native to Europe and extensively studied there, the larvae of these species feed on Phragmites shoots. The effects on Phragmites plants are a reduction of shoot height and significant dieback (Blossey et al. 2002). Testing is underway for host specificity, which determines whether or not the biological agents may impact non-target species such as other marsh vegetation or economically important plant species. Extensive research will be conducted before these insects can be recommended or approved for use as biological control agents.

METHODS FOR MONITORING PHRAGMITES

Monitoring the results of Phragmites control treatments provides critical information allowing landowners and resource managers to assess the efficacy of their actions. Monitoring documents the effects that control actions have toward accomplishing management goals and provides support for future management decisions (Noss and Cooperrider 1994). Various approaches are available for monitoring plant populations (Menges and Gordon 1996). Qualitative methods include mapping species occurrences, identifying presence/absence or spatial extent of a population, and documentation of change using photography. Quantitative methods involve assessment of abundance by measurements of density, cover, or frequency. A specialized form of quantitative monitoring used with Phragmites on the Eastern Shore Seaside involves repeated measures of an entire population, or census methods. Monitoring the effectiveness of Phragmites treatments can be accomplished by either qualitative or low-intensity quantitative methods. The following examples illustrate this array of approaches.

Photomonitoring

Photomonitoring is a qualitative and simple way to document changes in a plant population over time. Photomonitoring can be conducted by using small defined plots (photoplots) within a study population or by framing the same landscape or feature from exactly the same location (photopoint) each time the photograph is retaken. Comparison of photographs reveals changes in the condition of vegetation over the time span between photos (Figure 8A and 8B).

A.

B.

Figure 7. Photomonitoring of Phragmites on Parramore Island. (A) Pre-treatment (2003) and (B) post-treatment (2006) photos.

Quantitative Monitoring

The objectives of a 2008 DCR Phragmites monitoring project were 1) to determine the most effective application rate (5 vs. 7.5 gallons per acre) of Habitat™ herbicide for control of Phragmites, and 2) to determine the rate and composition of native plant colonization after herbicide treatments.

Monitoring sites on the Eastern Shore included Magothy Bay and Parramore Island state natural area preserves and the Eastern Shore of Virginia and Wallops Island national wildlife refuges (Figure 7).

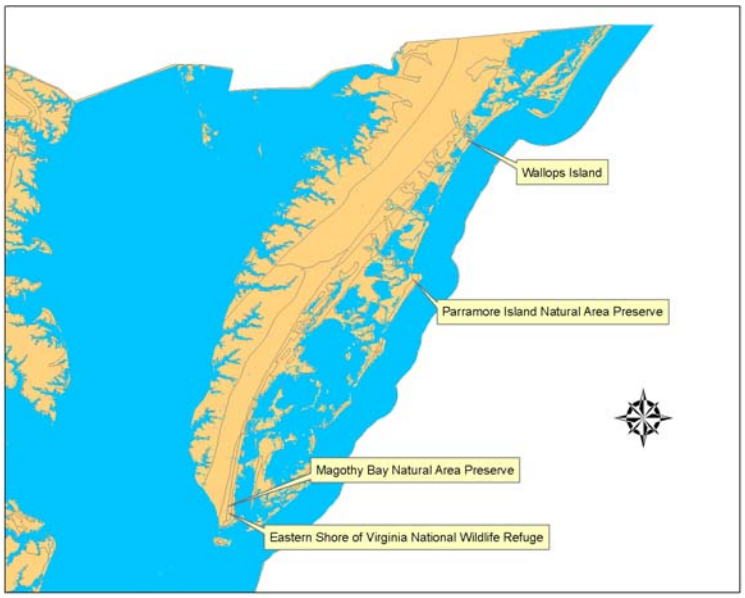

Figure 1. Monitoring sites on Virginia's Eastern Shore.

Within each monitoring site, a treatment area was designated and 5 to 30 quadrats were randomly established along transects. The following data was collected for Phragmites and all other plant species within each quadrat:

- Cover class (Daubenmire) by species
- Number of stems / individuals per species
- Mean height
- Mean water depth (if applicable)

Cover classes were also assigned for surface water, bare ground, and surface litter. Data was collected before and after herbicide treatments. The attributes of cover classes, mean heights, and number of stems were combined to yield a Relative Importance Value which was used in statistical analyses to compare treatment differences.

Aerial Census and Mapping

In both 2004 and 2008 DCR conducted an aerial GPS census of Phragmites on the Seaside using a helicopter as a search and mapping platform. The goal was to locate, document, and map all patches of Phragmites on the Seaside (Myers et al. 2004).

Following the first (2004) survey, a set of eight map sheets were compiled into an Atlas of the Distribution and Abundance of Phragmites on the Eastern Shore (Figure 5). A digital data layer was used to create the Virginia Phragmites Mapping Tool (http://128.172.160.130/phrag/ displaying Phragmites patch locations on the Eastern Shore Seaside and allowing landowners to assess invasions on their property (Figure 6).

A second aerial Phragmites survey was conducted for the Seaside in 2008. Comparison of 2004 and 2008 data has revealed the effectiveness of Phragmites control actions and the degree to which uncontrolled Phragmites has expanded during the four-year census interval (Table 3). Repeated Phragmites census allows several comparisons: 1) changes in area covered and number of patches by patch size class; 2) changes in Phragmites area for sites where control actions were conducted; and 3) changes in Phragmites abundance where control actions were not conducted (Table 3).

Table 3. Seaside Phragmites census results by patch size class.

	2004	2008	Change	Percent Change
Total Acres	1968	1902	-66	-3%
Patch Count	1236	1875	639	50%
Average Size	1.4	0.9	-0.5	64%
Median Size	0.25	0.25	0	0%
Small Patches				
Acres	126	235	109	87%
Patch Count	698	1172	474	68%
Average Size	0.2	0.2	0	0%
Median Size	0.2	0.2	0	0%
Medium Patches				
Acres	484	589	105	22%
Patch Count	456	629	173	38%
Average Size	1.1	0.9	-0.2	18.00%
Median Size	0.8	0.6	-0.2	25%
Large Patches				
Acres	1358	1078	-280	-21%
Patch Count	82	74	-8	-10%
Average Size	14	11	-3	-21%
Median Size	10	9	-1	-10%

Treated sites. Seaside Heritage Program funding from 2005 to 2008 supported 633 acres of Phragmites control treatments applied on lands held in the public interest. Additional control treatments were applied during this period by TNC, USFWS, and private landowners totaling 2160 acres treated. The 2004 and 2008 aerial surveys provide a means to monitor and assess the cumulative effects of these combined treatment efforts (Table 4).

Most treated sites showed a decrease in Phragmites cover. For the eight treated sites where Phragmites abundance was reduced, the net decrease was 233 acres for an average reduction of 33% (Table 4; Figures 9 – 11).

However, three treated sites (Mockhorn WMA, Parramore Island NAP, Wreck Island NAP) showed small increases in Phragmites abundance during the census interval (Table 4). These results indicate that treatment methods need to be improved in order to achieve more effective and lasting control of Phragmites. Improvements in methods resulting from these monitoring results include an operational shift to higher spray volumes and an emphasis on follow-up treatment in the year after initial treatment.

Table 4. Changes in Phragmites abundance at sites receiving herbicide treatments during the 2004 to 2008 census interval.

	Land owner	2004 (acres)	Last treated	2008 (acres)	Change (acres)	Percent change
Cobb's Island	TNC	8	2006	3	-5.0	-62%
Eastern Shore of Virginia National Wildlife Refuge	USFWS	46	2007	19	-27	-59%
Fisherman Island National Wildlife Refuge	USFWS	66	2007	55	-11	-17%
Magothy Bay Natural Area Preserve	VDCR	36	2007	16	-20	-56%
Mockhorn Wildlife Management Area	VDGIF	8	2007	10	2	+25%
Mockhorn Bay private lands	private	90	2007	25	-65	-72%
Mutton Hunk Fen Natural Area Preserve	VDCR	4	2007	3	-1	-25%
Parramore Island Natural Area Preserve	TNC	196	2006	197	1	+0.5%
Smith's Island	TNC	33	2006	23	-10	-30%
Wallops Island	USFWS	414	2007	320	-94	-23%
Wreck Island Natural Area Preserve	VDCR	8	2006	12	4	+50%

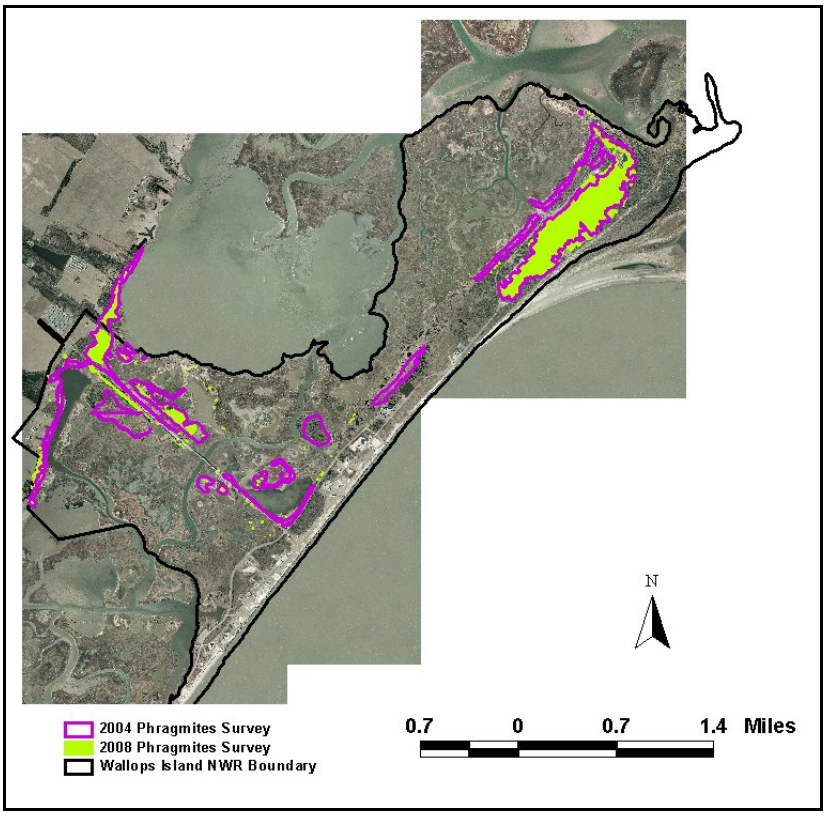

Figure 9. At Wallops Island control actions reduced Phragmites cover by 93 acres or 23% from 2004 to 2008.

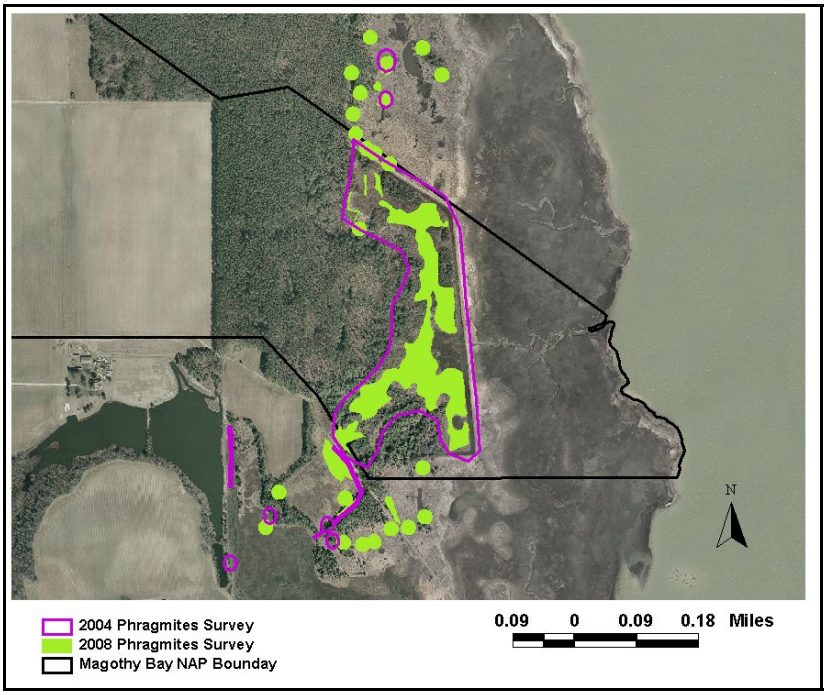

Figure 10. At Magothy Bay Natural Area Preserve, Phragmites treated in successive years (2006 and 2007) with imazapyr-based herbicides showed a reduction from 36 acres to 16 acres (- 56%).

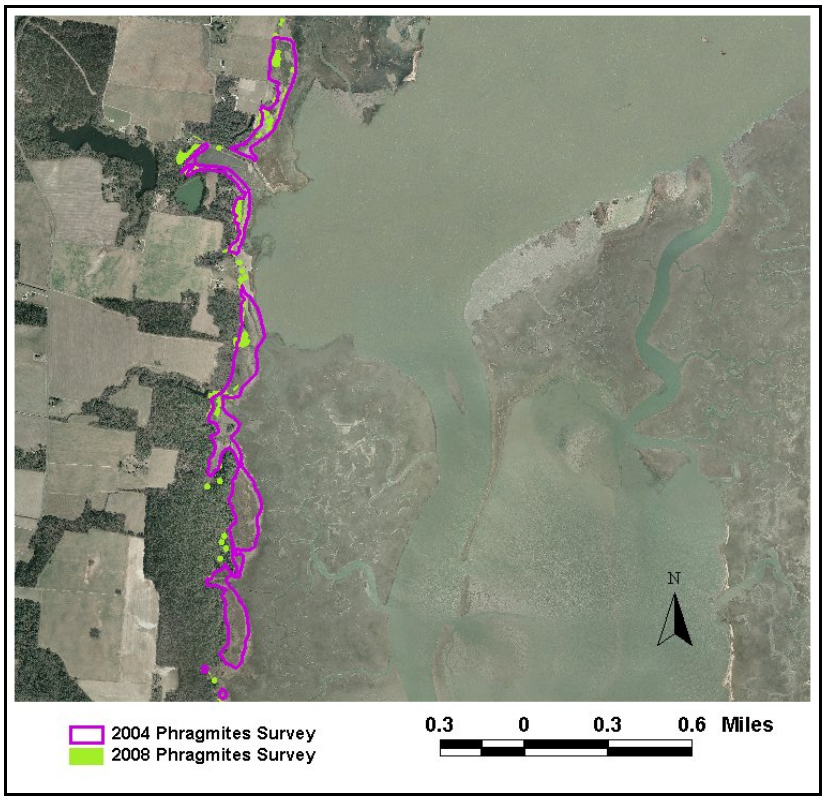

Figure 11. Treated private lands bordering Mockhorn Bay had a decrease in Phragmites cover from 90 to 25 acres from 2004-2008.

Untreated sites. The 2004 census indicated that an area of the Seaside near the mouth Machipongo River and including Upshur Neck was only lightly invaded by Phragmites, with 45 acres occurring. No control actions are known to have occurred during the period 2004 to 2008. The 2008 census indicated the same area supported 96 acres (Figure 12). An area of wet, harvested forest and two other large disturbed areas on Upshur Neck appear to have been rapidly invaded during this period. Phragmites within this area of the Seaside, with no control actions to slow it down, more than doubled in terms of both area covered and numbers of patches.

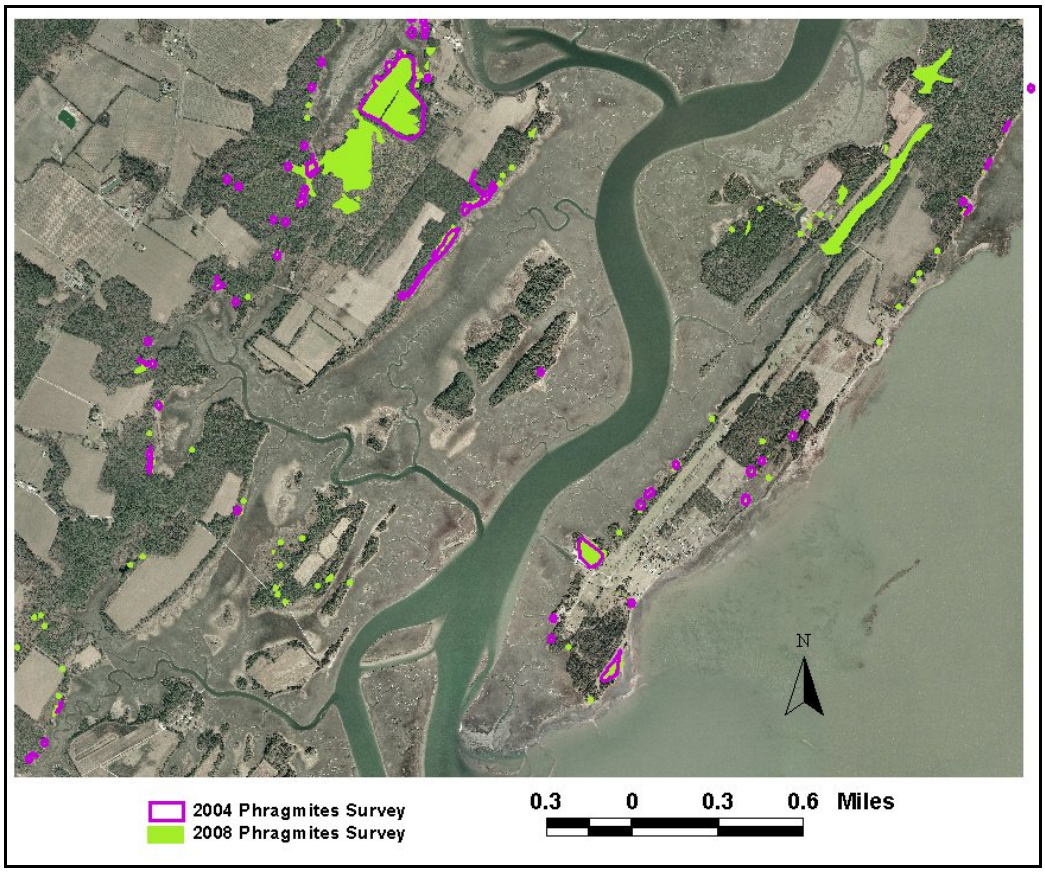

Figure 12. Phragmites cover at untreated Machipongo River sites increased from 45 acres in 2004 to 96 acres in 2008.

MANAGEMENT PRESCRIPTIONS FOR SPECIFIC SEASIDE HABITATS

General Guidelines

Herbicide treatments should be used to control most Phragmites infestations although mowing may be used effectively in certain limited situations. Combined methods can be used when circumstances and resources allow, and when such methods do not conflict with management goals for a site. For example, successive herbicide treatments combined with burning may be appropriate in an open marsh site far from houses when re-establishment of native vegetation is a priority. However, this approach may not be cost effective for an agricultural field or commercial forest, or would be unsafe if the setting involved nearby houses or buildings.

Ground-based spraying using backpack sprayers is feasible for individual stands of Phragmites smaller than about 1/10th acre and if the site is readily accessible by land or water. Larger stands, up to about five acres, may be controlled using ground methods but require powered portable pumps and sprayers mounted on an ATV, truck, amphibious vehicle, or boat.

Aerial application will, in most cases, be required for areas over five acres. For areas from one to five acres, costs for aerial vs. ground application should be compared and it is wise to acquire cost quotes for both methods. To bring costs down, landowners should consider partnering with adjacent and nearby neighbors to develop a mutual contract with an aerial herbicide applicator.

Marsh-upland Interface

Phragmites often becomes established in the zone between low marsh and upland, probably due to lower salinity levels in the water table and less frequent flooding. If the upland is in shrub or forest, these sites can be difficult to access from either land or water. Aerial spraying may be the most feasible treatment in this situation. If the upland is in agricultural use or lawn, mowing may be an option if soils are dry enough to support equipment and personnel.

Open Marsh

Due to difficult access, disturbance to wetland soils caused by ground-based equipment, and risk to personnel due to uncertain footing, aerial or boat-based herbicide treatments are recommended for Phragmites control in open marsh settings. Herbicide treatment followed by prescribed fire can improve control and speed the re-establishment of native marsh plant species by clearing dead thatch. For patches less than five acres, ground-based application may be feasible but aerial application should be considered. Patches larger than about five acres are usually best treated with aerial spraying.

Barrier Islands

Phragmites can establish on beaches and in dune swales and interior marsh of barrier islands on the Seaside. Phragmites management on barrier islands presents two major challenges. First, barrier island patches are difficult to access with equipment and personnel. Second, they may provide habitat for rare beach or marsh nesting birds. Treatments should not be applied during nesting season, from early April until late July. Human activity near the nests may damage nests or eggs and disturbance to the adult birds may cause them to abandon nests and young. Small Phragmites patches may be cut and sprayed. Larger patches require aerial spraying.

Forest Understory
Generally, Phragmites grows in open settings and does poorly in the shade of trees. However, Phragmites can occur in wet, open forests and woodlands such as those either recently thinned or impacted by strong wind storms. Phragmites can also expand into forests from adjacent marshes and wet fields. Wet pine forest edges are especially prone to invasion by Phragmites. These sites are often difficult to access by foot or with ground equipment due to thick vegetation which often includes greenbrier and other woody vines.

The first step for treatment of Phragmites in a forest understory is to treat adjacent Phragmites patches in open habitat that may be connected to and support the stems in the forest understory. If there is no adjacent Phragmites patch, a combined treatment of brushcutting followed by herbicide treatment on the re-sprouted Phragmites stems should provide control for small patches. Large forest understory patches may require aerial spraying. While pines and other conifer species are generally not damaged by imazapyr-based herbicides, the product label should be consulted and all application instructions followed carefully.

Pine Timberlands
Managed pine forests in low areas near wetlands are frequently invaded by Phragmites, especially following timber harvests. Establishment of Phragmites can be rapid after harvesting due to soil disturbance and increased sunlight. Even if new pine stands are successfully established, Phragmites is likely to persist in the understory. Phragmites patches in these forests may supply propagules, through seed and rhizome fragments, to adjacent wetlands. Ground-based or aerial application of imazapyr herbicide is recommended since these have little to no impact on conifer species have been used in forest management for competition control for many years.

Stream Headwaters
In most stream headwaters, the only option for Phragmites control is aerial application of herbicide. Characterized by a mix of shrubby and herbaceous vegetation, these sites are frequently inaccessible by boat and often surrounded by forest with a dense understory. Stream headwater patches may supply propagules through seed and rhizome fragments, which establish new patches downstream, and therefore, should be a high priority for treatment.

Wet Fields and Lawns
Agricultural fields and lawns adjacent to wetlands are frequently invaded by Phragmites due to soil disturbance, low competition, and high soil nutrient levels. Low, wet areas of fields and lawns are most likely to become infested. Mowing or herbicide treatments will provide control.

Impoundments, Ponds, and Ditches
Where water levels can be manipulated, lowering the water level and cutting or burning Phragmites, then re-flooding the site has resulted in reduction of Phragmites. In one study, three feet of water covering the rhizomes for four months during the growing season was required to cause mortality. Another method successfully combined mowing with flooding, which covered the cut Phragmites stems with brackish water (Marks et al. 1993).

Boat Docks and Boardwalks
Areas around boat docks and boardwalks may become infested after construction or maintenance has disturbed soils and removed competing vegetation. The tall stature of Phragmites often degrades the view from these structures and reduces their usefulness. Rapid response with cutting equipment and/or an herbicide treatment will help keep a new infestation from becoming large, difficult, and expensive to control.

Powerline Rights-of-way
Rights-of-way through wet areas are frequently invaded by Phragmites. Maintenance activities using equipment disturbs soils and facilitates invasion. Herbicide treatments are usually necessary to provide control. However, extra steps might also be required to prevent re-infestation. Maintenance equipment and vehicles that come into contact with Phragmites should be thoroughly cleaned of vegetation fragments before entering other rights-of way sites to reduce unintentional spread.

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APPENDICES

A. Plant Conservation Alliance Phragmites Fact Sheet (Saltonstall 2005)

B. Example Glyphosate Herbicide Label

C. Example Imazapyr Herbicide Label

D. Potential Vendors for Herbicide Control of Phragmites in Virginia

Appendix A.

Plant Conservation Alliance Phragmites Fact Sheet

FACT SHEET: GIANT REED

Common Reed

Phragmites australis (Cav.) Trin. ex Steud.
Grass family (Poaceae)

NATIVE RANGE

Eurasia

DESCRIPTION

Common reed, or Phragmites, is a tall, perennial grass that can grow to over 15 feet in height. In North America, both native phragmites (*Phragmites australis* ssp. *americanus* Saltonstall, P.M. Peterson & Soreng) and introduced subspecies are found. Introduced Phragmites forms dense stands which include both live stems and standing dead stems from previous year's growth. Leaves are elongate and typically 1-1.5 inches wide at their widest point. Flowers form bushy panicles in late July and August and are usually purple or golden in color. As seeds mature, the panicles begin to look "fluffy" due to the hairs on the seeds and they take on a grey sheen. Below ground, Phragmites forms a dense network of roots and rhizomes which can go down several feet in depth. The plant spreads horizontally by sending out rhizome runners which can grow 10 or more feet in a single growing season if conditions are optimal.

Please see the table below for information on distinguishing betweeen native and introduced Phragmites.

ECOLOGICAL THREAT

Once introduced Phragmites invades a site it quickly can take over a marsh community, crowding out native plants, changing marsh hydrology, altering wildlife habitat, and increasing fire potential. Its high biomass blocks light to other plants and occupies all the growing space belowground so plant communities can turn into a Phragmites monoculture very quickly. Phragmites can spread both by seed dispersal and by vegetative spread via fragments of rhizomes that break off and are transported elsewhere. New populations of the introduced type may appear sparse for the first few years of growth but due to the plant's rapid growth rate, they will typically form a pure stand that chokes out other vegetation very quickly.

DISTRIBUTION IN THE UNITED STATES

Phragmites occurs throughout the lower 48 states and southern Canada. It has been reported to be invasive in natural areas in 18 states including Colorado, Connecticut, Delaware, Georgia, Indiana, Kentucky, Maryland, Michigan, North Carolina, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Tennessee, Virginia, Vermont, and Wisconsin, and the District of Columbia.

HABITAT IN THE UNITED STATES

Tidal and nontidal brackish and freshwater marshes, river edges, shores of lakes and ponds, roadsides, disturbed areas.

BACKGROUND

Preserved remains of native Phragmites that are 40,000 years old have been found in the southwest indicating that it is a part of the native flora of that region. In coastal areas, preserved rhizome fragments dating back 3000-4000 years have also been found in salt marsh sediments indicating that it is also native to these habitats. Native American uses of Phragmites include use of stems for arrow shafts, musical instruments, ceremonial objects, cigarettes, and both leaves and stems for constructing mats.

Introduced Phragmites is thought to have arrived in North America accidentally, most likely in ballast material in the late 18th or early 19th centuries. It established itself along the Atlantic coast and over the course of the 20th century, spread across the continent. In Europe Phragmites is grown commercially and is used for thatching, fodder for livestock, and cellulose production. It is also declining in parts of Europe which has been of concern to natural resource managers there. Here in the United States it is not used for many purposes.

BIOLOGY & SPREAD
While each Phragmites plant may produce thousands of seeds annually, seed viability is typically low although there appears to be a great deal of interannual variation in fecundity. Dispersal to new sites is typically by seed except along rivers and shorelines where fragments of rhizomes may be washed down to new sites where they can establish. Along roadsides, rhizomes fragments may also be transported by heavy machinery between sites. At this time, there is no evidence for hybrid native/introduced populations occurring in the field.

MANAGEMENT OPTIONS
Areas with large, established, populations of Phragmites are best restored using herbicides. Other options include mowing and prescribed burning.

Biological
At this time no means of biological control are available in the United States for treating Phragmites infestations.

Chemical
Glyphosate-based herbicides (e.g., Rodeo®) are the most effective control method for established populations. If a population can be controlled soon after it has established chances of success are much higher because the below-ground rhizome network will not be as extensive. Herbicides are best applied in late summer/early fall after the plant has flowered either as a cut stump treatment or as a foliar spray. It is often necessary to do repeated treatments for several years to prevent any surviving rhizomes from resprouting. When applying herbicides in or around water or wetlands, be sure to use products labeled for that purpose to avoid harm to aquatic organisms.

Fire
Prescribed burning after the plant has flowered, either alone or in combination with herbicide treatment, may also be effective. Burning after herbicide treatment also reduces standing dead stem and litter biomass which may help to encourage germination of native plants in the following growing season. Plants should not be burned in the spring or summer before flowering as this may stimulate growth.

Mechanical
This type of control (e.g., repeated mowing) may be effective at slowing the spread of established stands but is unlikely to kill the plant. Excavation of sediments may also be effective at control but if small fragments of root are left in the soil, they may lead to reestablishment.

USE PESTICIDES WISELY: Always read the entire pesticide label carefully, follow all mixing and application instructions and wear all recommended personal protective gear and clothing. Contact your state department of agriculture for any additional pesticide use requirements, restrictions or recommendations.

NOTICE: mention of pesticide products on this page does not constitute endorsement of any material.

CONTACTS
For more information on identification and control of Phragmites, contact:

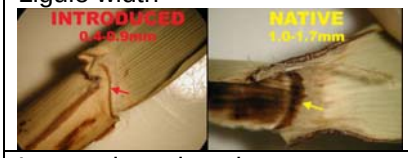
- Dr. Kristin Saltonstall, Adjunct Research Scientist, Horn Point Laboratory, University of Maryland Center for Environmental Science, (914) 526-2498, ksalton at hpl.umces.edu

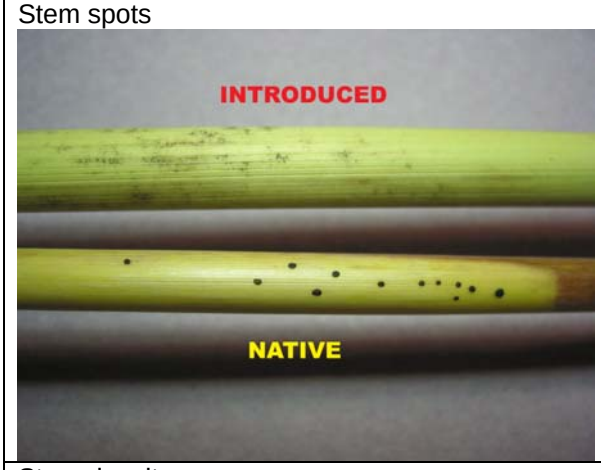
SUGGESTED ALTERNATIVE PLANTS
Native plant species that are adapted to local conditions should be used in restoration projects and as a substitute for Phragmites erosion control practices.

How to Distinguish Native and Introduced Phragmites plants:

It can be difficult to definitively distinguish native from introduced Phragmites plants without genetic testing due to the plasticity of the species and its ability to adapt to a wide range of conditions. However, a number of morphological characteristics have now been identified that can be used to determine a population's type. These characters can be subtle (e.g. color variation) and subjective making positive identification difficult. Given this, an assignment of native or introduced status to a population should not be made unless several characters clearly match the patterns shown in table 1.

Table 1: Morphological characters useful in distinguishing Native and Introduced Phragmites populations.*

CHARACTER **Photo**	**NATIVE**	**INTRODUCED**
Ligule width** 	1.0-1.7 mm	0.4-0.9 mm
Lower glume length 	3.0-6.5 mm	2.5-5.0 mm
Upper glume length	5.5-11.0 mm	4.5-7.5 mm
Adherence of leaf sheaths** 	Loose – both leaves and leaf sheaths are usually dropped as the plant senesces	Tight – leaves may drop off but leaf sheaths typically adhere tightly to dead stems

CHARACTER Photo	NATIVE	INTRODUCED
Stem color (look under the leaf sheaths, especially in places where the stem is exposed to sunlight)  	Summer – green to maroon, may have maroon color at the nodes only Winter – yellow to brown	Summer – typically all green with yellowish nodes although some lower nodes may have maroon color Winter – yellow
Stem spots  	Small round fungal spots MAY be present in late summer and on dead stems	Extremely rare. Patches of black filamentous fungi may be seen
Stem density	May occur as a monoculture, often co-occurs with other plant species	Typically grows as a monoculture, young newly established populations and those in areas of high salinity may be less dense

CHARACTER Photo	NATIVE	INTRODUCED
Leaf color   	Yellow-green – usually lighter than introduced	Blue-green in most habitats but may be yellow-green in brackish habitats
Habitat	Undisturbed sites MidAtlantic – fresh to oligohaline tidal marshes Midwest – fens, marshes	Highly disturbed to undisturbed sites, dominates brackish marshes along the Atlantic coast, common along roadsides throughout the U.S.

* This table should not be used to distinguish between Phragmites populations along the Gulf Coast where another type of Phragmites, the Gulf Coast type, which looks similar to introduced Phragmites, is also found.
** Most reliable characters distinguishing native from introduced Phragmites.

OTHER LINKS

- http://www.invasive.org/search/action.cfm?q=Phragmites%20australis
- http://www.lib.uconn.edu/webapps/ipane/browsing.cfm?descriptionid=85
- http://www.nps.gov/plants/alien/fact/pdf/phau1-powerpoint.pdf

AUTHOR

Dr. Kristin Saltonstall, Adjunct Research Scientist, Horn Point Laboratory University of Maryland Center for Environmental Science, Solomon, MD

EDITOR

Jil M. Swearingen, National Park Service, Center for Urban Ecology, Washington DC

PHOTOGRAPHS

Jil M. Swearingen, National Park Service, Center for Urban Ecology, Washington DC
Dr. Kristin Saltonstall, Adjunct Research Scientist, Horn Point Laboratory University of Maryland Center for Environmental Science, Solomon MD
R.E. Meadows

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U.S.Department of Agriculture. 2005. Natural Resources Conservation Service Plants Database. http://plants.usda.gov/

Appendix B.

Example Glyphosate Herbicide Label

Specimen Label

Dow AgroSciences™

Rodeo®

Herbicide

For control of annual and perennial weeds and woody plants in forests, non-crop sites, and in and around aquatic sites; also for use in wildlife habitat areas, for perennial grass release, and grass growth suppression and grazed areas on these sites.

Avoid contact of herbicide with foliage, green stems, exposed non-woody roots or fruit of crops, desirable plants and trees, because severe injury or destruction may result.

Active Ingredient(s):	
glyphosate† N-(phosphonomethyl)glycine, isopropylamine salt	53.8%
Other Ingredients	46.2%
Total Ingredients	100.0%

† Contains 5.4 pounds per gallon glyphosate, isopropylamine salt (4 pounds per gallon glyphosate acid).

EPA Reg. No. 62719-324

Keep Out of Reach of Children

CAUTION PRECAUCION

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

Harmful If Inhaled

Avoid breathing spray mist. Remove contaminated clothing and wash before reuse. Wash thoroughly with soap and water after handling.

Personal Protective Equipment (PPE)

Applicators and other handlers must wear:

- Long-sleeved shirt and long pants
- Shoes plus socks.

Follow manufacturer's instructions for cleaning/maintaining PPE (Personal Protective Equipment). If no such instructions for washables, 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 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.

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

If inhaled: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably 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. You may also contact 1-800-992-5994 for emergency medical treatment information.

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 leak or spill, soak up and remove to a landfill.

Physical or Chemical Hazards

Spray solutions of this product should be mixed, stored and applied using only stainless steel, aluminum, 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.

Notice: Read the entire label. Use only according to label directions. **Before using this product, read Terms and Conditions of Use, 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.

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.

This is an end-use product. Dow AgroSciences does not intend and has not registered it for reformulation. See individual container label for repackaging limitations.

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 4 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

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.

Keep people and pets off treated areas until spray solution has dried.

Storage and Disposal

Do not contaminate water, food, feed or seed by storage or disposal.
Pesticide Storage: Store above 10°F (-12°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.
Pesticide Disposal: Wastes resulting from use of this product that cannot be used or chemically reprocessed should be disposed of in a landfill approved for pesticide disposal or in accordance with applicable Federal, state or local procedures.

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 larger than 5 gallons:
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 larger than 5 gallons:
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
(How this product works)

This product is a water-soluble liquid, which mixes readily with water and nonionic surfactant to be applied as a foliar spray for the control or destruction of many herbaceous and woody plants. This product is intended for control of annual and perennial weeds and woody plants in forests, pine straw plantations, non-crop sites such as utility rights-of-way, and in and around aquatic sites; also for use in wildlife habitat areas, for perennial grass release, and grass growth suppression and grazed areas on these sites.

The active ingredient in this product moves through the plant from the point of foliage contact to and into the root system. Visible effects on most annual weeds occur within 2 to 4 days, 7 days or more on most perennial weeds, and 30 days or more on most woody plants. Extremely cool or cloudy weather following treatment may slow the activity of this product and delay visual effects of control. Visible effects include gradual wilting and yellowing of the plant which advances to complete browning of above-ground growth and deterioration of underground plant parts.

Unless otherwise directed on this label, delay application until vegetation has emerged and reached the stages described for control of such vegetation under the "Weeds Controlled" section of this label.

Unemerged plants arising from unattached underground rhizomes or root stocks of perennials or brush will not be affected by the spray and will continue to grow. For this reason best control of most perennial weeds or brush is obtained when treatment is made at late growth stages approaching maturity.

Always use the higher rate of this product and surfactant within the recommended range when vegetation is heavy or dense, when treating dense multi-canopied sites or woody vegetation or difficult-to-control herbaceous or woody plants.

Do not treat weeds, brush or trees under poor growing conditions such as drought stress, disease or insect damage, as reduced control may result. Reduced control of target vegetation may also occur if foliage is heavily covered with dust at the time of treatment.

Reduced control may result when applications are made to woody plants or weeds following site disturbance or plant top growth removal from grazing, mowing, logging or mechanical brush control. For best results, delay treatment of such areas until resprouting and foliar growth has restored the target vegetation to the recommended stage of growth for optimum herbicide exposure and control.

Rainfall or irrigation occurring within 6 hours after application may reduce effectiveness. Heavy rainfall or irrigation within 2 hours after application may wash the product off the foliage and a repeat treatment may be required.

This product does not provide residual weed control. For subsequent residual weed control, follow a label-approved herbicide program. Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used.

Note: The maximum rates stated throughout this product's labeling apply to this product combined with the use of all other herbicides containing glyphosate or sulfosate as the active ingredient, whether applied as mixtures or separately. Calculate the application rates and ensure that the total use of this and other glyphosate or sulfosate containing products does not exceed the maximum use rates.

Grazing Restrictions: This product may be used to treat undesirable vegetation in utility rights-of-way that pass through pastures, rangeland, and forestry sites that are being grazed. For tank mix applications, comply with all restrictions appearing on the tank mix product label.

Except for lactating dairy animals there are no grazing restrictions following the labeled applications of this product.

- For lactating dairy animals there are no grazing restrictions for the following labeled applications of this product:
  - ▶ Where the spray can be directed onto undesirable woody brush and trees, such as in handgun spray-to-wet or low volume directed spray treatments.
  - ▶ For tree injection of frill applications and for cut stump treatments
- For broadcast applications, observe the following restrictions for lactating dairy animals:
  - ▶ For application rates of greater than 4.5 but not to exceed 7.5 quarts per acre, no more than 15 percent of the available grazing area may be treated.
  - ▶ For application rates that do not exceed 4.5 quarts per acre, no more than 25 percent of the available grazing area may be treated.
- These restrictions do not apply to pastures, rangeland or forestry sites outside of utility rights-of-way.

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. When not in use, keep container closed to prevent spills and contamination.

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

ATTENTION: 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 plant or crop injury occurring from the use of this product is greatest when winds are gusty or in excess of 5 miles per hour or when other conditions, including lesser wind velocities, will allow spray drift to occur. When spraying, avoid combinations of pressure and nozzle type that will result in splatter or fine particles (mist) which are likely to drift. **Avoid applying at excessive speed or pressure.**

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 to agricultural field crops. These requirements do not apply to forestry applications, public health uses or to applications using dry formulations.

1. The distance of the outer most 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.

The applicator should be familiar with and take into account the information covered in the following **Aerial Drift Reduction Advisory Information**:

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 Wind, Temperature and Humidity, and Temperature Inversion section of this label).

Controlling Droplet Size: Volume-Use high flow rate nozzles to apply the highest practical spray volume. Nozzles with higher rated flows product 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 airstream 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-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 2-10 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 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 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 connected cloud (under low wind conditions) indicates an inversion, while smoke that moves upwards 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).

Mixing And Application Instructions

Apply these spray solutions in properly maintained and calibrated equipment capable of delivering desired volumes. Hand-gun applications should be properly directed to avoid spraying desirable plants. Note: reduced results may occur if water containing soil is used, such as water from ponds and unlined ditches.

Mixing

This product mixes readily with water. Mix spray solutions of this product as follows:

1. Fill the mixing or spray tank with the required amount of water while adding the required amount of this product (see “Directions for Use” and “Weeds Controlled” sections of this label).
2. Near the end of the filling process, add the required surfactant and mix well. Remove hose from tank immediately after filling to avoid siphoning back into the water source.

Note: If tank mixing with Garlon® 3A herbicide, ensure that Garlon 3A is well mixed with at least 75 percent of the total spray volume before adding this product to the spray tank to avoid incompatibility.

During mixing and application, foaming of the spray solution may occur. To prevent or minimize foam, avoid the use of mechanical agitators, place the filling hose below the surface of the spray solution (only during filling), terminate by-pass and return lines at the bottom of the tank, and, if needed, use an approved anti-foam or defoaming agent.

Keep by-pass line on or near bottom of tank to minimize foaming. Screen size in nozzle or line strainers should be no finer than 50 mesh. Carefully select correct nozzle to avoid spraying a fine mist. For best results with conventional ground application equipment, use flat fan nozzles. Check for even distribution of spray droplets.

IMPORTANT: When using this product, unless otherwise specified, mix with a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient. For conifer release (pine release) use only surfactants that are approved for conifer release, and specified on the surfactant label as safe for use in conifer release (pine release).
Always read and follow the manufacturer's surfactant label recommendations for best results.

Colorants or marking dyes approved for use with herbicides may be added to spray mixtures of this product. Colorants or dyes used in spray solutions of this product may reduce performance, especially at lower rates or dilutions. Use colorants or dyes according to the manufacturer's label recommendations.

Clean sprayer and parts immediately after using this product by thoroughly flushing with water and dispose of rinsate according to labeled use or disposal instructions.

Carefully observe all cautionary statements and other information appearing in the surfactant label.

Application Equipment And Techniques

ATTENTION: AVOID DRIFT. EXTREME CARE MUST BE EXERCISED 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 crops, plants, or other areas on which the treatment was not intended. The likelihood of plant or crop injury occurring from the use of this product is greatest when winds are gusty or in excess of 5 miles per hour or when other conditions, including lesser wind velocities, will allow spray drift to occur. When spraying, avoid combinations of pressure and nozzle type that will result in splatter or fine particles (mist) which are likely to drift. AVOID APPLYING AT EXCESSIVE SPEED OR PRESSURE.

Note: Use of this product in a manner not consistent with this label may result in injury to persons, animals, or crops, or other unintended consequences. When not in use, keep container closed to prevent spills and contamination.

Aerial Equipment

For aerial application of this product in California, refer to Federal supplemental label for this product entitled "For Aerial Application in California Only". In California, aerial application may be made in aquatic sites and noncrop areas, including aquatic sites present in noncrop areas that are part of the intended treatment.

For control of weed or brush species listed in this label using aerial application equipment: For aerial broadcast application, unless otherwise specified, apply the rates of this product and surfactant recommended for broadcast application in a spray volume of 3 to 20 gallons of water per acre. See the "Weeds Controlled" section of this label for labeled annual and herbaceous weeds and woody plants and broadcast rate recommendations. Aerial applications of this product may only be made as specifically recommended in this label.

AVOID DRIFT. Do not apply during inversion conditions, when winds are gusty or under any other condition which will allow drift. Drift may cause damage to any vegetation contacted to which treatment is not intended. To prevent injury to adjacent desirable vegetation, appropriate buffer zones must be maintained.

Coarse sprays are less likely to drift; therefore, do not use nozzles or nozzle configurations which dispense spray as fine spray droplets. Do not angle nozzles forward into the airstream and do not increase spray volume by increasing nozzle pressure.

Drift control additives may be used. When a drift control additive is used, read and carefully observe the cautionary statements and all other information appearing in the additive label. The use of a drift control agent for conifer and herbaceous release applications may result in conifer injury and is not recommended.

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

Thoroughly wash aircraft, especially landing gear, after each day of spraying to remove residues of this product accumulated during spraying or from spills. **Prolonged exposure of this product to uncoated steel surfaces may result in corrosion and possible failure of the part. Landing gear are most susceptible.** The maintenance of an organic coating (paint) which meets aerospace specification MIL-C-38413 may prevent corrosion.

Ground Broadcast Equipment

For control of weed or brush species listed in this label using conventional boom equipment: For ground broadcast application, unless otherwise specified, apply the rates of this product and surfactant recommended for broadcast application in a spray volume of 3 to 30 gallons of water per acre. See the "Weeds Controlled" section of this label for labeled annual and herbaceous weeds and woody plants and broadcast rate recommendations. As density of vegetation increases, spray volume should be increased within the recommended range to ensure complete coverage. Carefully select correct nozzle to avoid spraying a fine mist. For best results with ground application equipment, use flat fan nozzles. Check for even distribution of spray droplets.

Forestry and Utility Rights-of-Way Sites: This product is recommended for broadcast applications using suitable ground equipment in forestry sites, utility sites, and utility rights-of way. Apply the recommended rates of this product and surfactant in a spray volume of 10 to 60 gallons per acre. Check for even distribution of spray droplets.

Hand-Held and High-Volume Equipment
(Use Coarse Sprays Only)

For control of weeds listed in this label using knapsack sprayers or high-volume spraying equipment utilizing handguns or other suitable nozzle arrangements:

High volume sprays: Prepare a **3/4 to 2 percent solution** of this product in water, add a nonionic surfactant and apply to foliage of vegetation to be controlled. For specific rates of application and instructions for control of various annual and perennial weeds, see the "Weeds Controlled" section in this label.

Applications should be made on a spray-to-wet basis. Spray coverage should be uniform and complete. Do not spray to point of runoff.

Low volume directed sprays: This product may be used as a **5 to 10 percent solution** in low-volume directed sprays for spot treatment of trees and brush. This treatment method is most effective in areas where there is a low density of undesirable trees or brush. 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 zig-zag motion. Ensure that at least 50 percent of the leaves are contacted by the spray solution. For flat fan and cone nozzles and with hand-directed mist blowers, mist the application over the foliage of the targeted vegetation. Small, open-branched trees need only be treated from one side. If the foliage is thick or there are multiple root sprouts, applications must be made from several sides to ensure adequate spray coverage.

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

Spray Solution

Desired Volume	Amount of this product							
	3/4%	**1%**	**1 1/4%**	**1 1/2%**	**2%**	**5%**	**8%**	**10%**
1 gal	1 fl oz	1 1/3 fl oz	1 2/3 fl oz	2 fl oz	2 2/3 fl oz	6 1/2 fl oz	10 1/4 fl oz	12 3/4 fl oz
25 gal	1 1/2 pt	1 qt	1 1/4 qt	1 1/2 qt	2 qt	5 qt	2 gal	2.5 gal
100 gal	3 qt	1 gal	1 1/4 gal	1 1/2 gal	2 gal	5 gal	8 gal	10 gal

2 tablespoons = 1 fluid ounce

For use in knapsack sprayers, it is suggested that the recommended amount of this product be mixed with water in a larger container. Fill the knapsack sprayer with the mixed solution and add the correct amount of surfactant.

Selective Equipment

This product may be applied through shielded sprayers or wiper application equipment. This equipment may be used to selectively control undesirable vegetation without harming desirable vegetation.

Shielded sprayers direct the herbicide solution onto weeds while shielding desirable vegetation from the spray solution. Any recommended rate or tank mixture of this product may be used employing this equipment.

Wiper applicators physically wipe product directly onto undesirable vegetation. Care should be taken to avoid wiping desirable vegetation. Use a 33 to 100 percent solution of this product, diluted in water for wiper applications. Use a 33 percent solution for wick or gravity feed systems. Higher concentrations may be used in pressurized systems that are capable of handling thicker solutions. Addition of a nonionic surfactant at a rate of 10 percent by volume of total herbicide solution is recommended.

Weeds Controlled

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 "Directions for Use," "General Information" and "Mixing and Application Instructions" for labeled uses and specific application instructions.

Broadcast Application Rates: For weeds less than 6 inches tall, use 1 1/2 pints of this product per acre plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient. If weeds are greater than 6 inches tall, use 2½ pints of this product per acre plus a non-ionic surfactant containing 80% or greater active ingredient..

Hand-Held, High-Volume Application Rates: Use a 3/4 percent solution of this product in water plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient. Apply to foliage of vegetation to be controlled.

When applied as directed, this product **plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient will control the following annual weeds:**

Common Name	Scientific Name
Balsamapple †	*Momordica charantia*
Barley	*Hordeum vulgare*
Barnyardgrass	*Echinochloa crus-galli*
Bassia, fivehook	*Bassia hyssopifolia*
Bluegrass, annual	*Poa annua*
Bluegrass, bulbous	*Poa bulbosa*
Brome	*Bromus spp.*
Buttercup	*Ranunculus spp.*
Cheat	*Bromus secalinus*
Chickweed, mouseear	*Cerastium vulgatum*
Cocklebur	*Xanthium strumarium*
Corn, volunteer	*Zea mays*
Crabgrass	*Digitaria spp.*
Dwarfdandelion	*Krigia cespitosa*
Falseflax, smallseed	*Camelina microcarpa*
Fiddleneck	*Amsinckia spp.*
Flaxleaf fleabane	*Conyza bonariensis*
Fleabane	*Erigeron spp.*
Foxtail	*Setaria spp.*
Foxtail, Carolina	*Alopecurus carolinianus*
Groundsel, common	*Senecio vulgaris*
Horseweed/Marestail	*Conyza canadensis*
Kochia	*Kochia scoparia*
Lambsquarters, common	*Chenopodium album*
Lettuce, prickly	*Lactuca serriola*
Morningglory	*Ipomoea spp.*
Mustard, blue	*Chorispora tenella*
Mustard, tansy	*Descurainia pinnata*
Mustard, tumble	*Sisymbrium altissimum*
Mustard, wild	*Sinapis arvensis*
Oats, wild	*Avena fatua*
Panicum	*Panicum spp.*
Pennycress, field	*Thlaspi arvense*
Pigweed, redroot	*Amaranthus retroflexus*
Pigweed, smooth	*Amaranthus hybridus*
Ragweed, common	*Ambrosia artemisiifolia*
Ragweed, giant	*Ambrosia trifida*
Rocket, London	*Sisymbrium irio*
Rye	*Secale cereale*
Ryegrass, Italian ††	*Lolium multiflorum*
Sandbur, field	*Cenchrus spp.*
Shattercane	*Sorghum bicolor*
Shepherd's-purse	*Capsella bursa-pastoris*
Signalgrass, broadleaf	*Brachiaria platyphylla*
Smartweed, Pennsylvania	*Polygonum pensylvanicum*
Sowthistle, annual	*Sonchus oleraceus*
Spanishneedles ††	*Bidens bipinnata*
Stinkgrass	*Eragrostis cilianensis*
Sunflower	*Helianthus annuus*
Thistle, Russian	*Salsola kali*
Spurry, umbrella	*Holosteum umbellatum*
Velvetleaf	*Abutilon theophrasti*
Wheat	*Triticum aestivum*
Witchgrass	*Panicum capillare*

† Apply with hand-held equipment only.
†† Apply 3 pints of this product per acre.

Annual weeds will generally continue to germinate from seed throughout the growing season. Repeat treatments will be necessary to control later germinating weeds.

Perennial Weeds

Apply this product to control most vigorously growing perennial weeds. Unless otherwise directed, apply when target plants are actively growing and most have reached early head or early bud stage of growth. Unless otherwise directed, allow at least 7 days after application before disturbing vegetation.

NOTE: If weeds have been mowed or tilled, do not treat until regrowth has reached the recommended stages. Fall treatments must be applied before a killing frost.

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

Specific Weed Control Recommendations: For perennial weeds, apply the recommended rate plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient.. Use of this product without surfactant will result in reduced herbicide performance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information. .
When applied as directed, this product plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient will control the following perennial weeds: (Numbers in parentheses "(-)" following common name of a listed weed species refer to "Specific Perennial Weed Control Recommendations" for that weed which follow the species listing.)

Common Name	Scientific Name
Alfalfa (31)	*Medicago sativa*
Alligatorweed † (1)	*Alternanthera philoxeroides*
Anise/Fennel (31)	*Foeniculum vulgare*
Artichoke, Jerusalem (31)	*Helianthus tuberosus*
Bahiagrass (31)	*Paspalum notatum*
Bermudagrass (2)	*Cynodon dactylon*
Bindweed, field (3)	*Convolvulus arvensis*
Bluegrass, Kentucky (12)	*Poa pratensis*
Blueweed, Texas (3)	*Helianthus ciliaris*
Brackenfern (4)	*Pteridium spp.*
Bromegrass, smooth (12)	*Bromus inermis*
Canarygrass, reed (12)	*Phalaris arundinacea*
Cattail (5)	*Typha spp.*
Clover, red (31)	*Trifolium pratense*
Clover, white (31)	*Trifolium repens*
Cogongrass (6)	*Imperata clylindrica*
Cordgrass (7)	*Spartina spp.*
Cutgrass, giant † (8)	*Zizaniopsis miliacea*
Dallisgrass (31)	*Paspalum dilatatum*
Dandelion (31)	*Taraxacum officinale*
Dock, curly (31)	*Rumex crispus*
Dogbane, hemp (9)	*Apocynum cannabinum*
Fescue (31)	*Festuca spp.*
Fescue, tall (10)	*Festuca arundinacea*
Guineagrass (11)	*Panicum maximum*
Hemlock, poison (31)	*Conium maculatum*
Horsenettle (31)	*Solanum carolinense*
Horseradish (9)	*Armoracia rusticana*
Ice Plant (22)	*Mesembryanthemum crystallinum*
Johnsongrass (12)	*Sorghum halepense*
Kikuyugrass (21)	*Pennisetum clandestinum*

Common Name	Scientific Name
Knapweed (9)	*Centaurea repens*
Lantana (13)	*Lantana camara*
Lespedeza, common (31)	*Lespedeza striata*
Lespedeza, sericea (31)	*Lespedeza cuneata*
Loosestrife, purple (14)	*Lythrum salicaria*
Lotus, American (15)	*Nelumbo lutea*
Maidencane (16)	*Panicum hematomon*
Milkweed (17)	*Asclepias spp.*
Muhly, wirestem (21)	*Muhlenbergia frondosa*
Mullein, common (31)	*Verbascum thapsus*
Napiergrass (31)	*Pennisetum purpureum*
Nightshade, silverleaf (3)	*Solanum elaeagnifolium*
Nutsedge, purple (18)	*Cyperus rotundus*
Nutsedge, yellow (18)	*Cyperus esculentus*
Orchardgrass (12)	*Dactylis glomerata*
Pampasgrass (19)	*Cortaderia jubata*
Paragrass (16)	*Brachiaria mutica*
Phragmites†† (20)	*Phragmites spp.*
Quackgrass (21)	*Agropyron repens*
Reed, giant (22)	*Arundo donax*
Ryegrass, perennial (12)	*Lolium perenne*
Smartweed, swamp (31)	*Polygonum coccineum*
Spatterdock (23)	*Nuphar luteum*
Starthistle, yellow (31)	*Centaurea solstitialis*
Sweet potato, wild † (24)	*Ipomoea pandurata*
Thistle, artichoke (25)	*Cynara cardunculus*
Thistle, Canada (25)	*Cirsium arvense*
Timothy (12)	*Phleum pratense*
Torpedograss † (26)	*Panicum repens*
Tules, common (27)	*Scirpus acutus*
Vaseygrass (31)	*Paspalum urvillei*
Velvetgrass (31)	*Holcus spp.*
Waterhyacinth (28)	*Eichornia crassipes*
Waterlettuce (29)	*Pistia stratiotes*
Waterprimrose (30)	*Ludwigia spp.*
Wheatgrass, western (12)	*Agropyron smithii*

† Partial control.

†† Partial control in southeastern states. See "Specific Weed Control Recommendations" below.

Specific Perennial Weed Control Recommendations:

1. **Alligatorweed:** Apply 6 pints of this product per acre as a broadcast spray or as a 1 1/4 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.
2. **Bermudagrass:** Apply 7 1/2 pints of this product per acre as a broadcast spray or as a 1 1/2 percent solution with hand-held equipment. Apply when target plants are actively growing and when seedheads appear.
3. **Bindweed, field / Silverleaf Nightshade / Texas Blueweed:** Apply 6 to 7 1/2 pints of this product per acre as a broadcast spray west of the Mississippi River and 4 1/2 to 6 pints of this product per acre east of the Mississippi River. With hand-held equipment, use a 1 1/2 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.
4. **Brackenfern:** Apply 4 1/2 to 6 pints of this product per acre as a broadcast spray or as a 3/4 to 1 percent solution with hand-held equipment. Apply to fully expanded fronds which are at least 18 inches long.
5. **Cattail:** Apply 4 1/2 to 6 pints of this product per acre as a broadcast spray or as a 3/4 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.
6. **Cogongrass:** Apply 4 1/2 to 7 1/2 pints 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.
7. **Cordgrass:** Apply 4 1/2 to 7 1/2 pints 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.
8. **Cutgrass, giant:** Apply 6 pints 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.
9. **Dogbane, hemp / Knapweed / Horseradish:** Apply 6 pints of this product per acre as a broadcast spray or as a 1 1/2 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.
10. **Fescue, tall:** Apply 4 1/2 pints 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.
11. **Guineagrass:** Apply 4 1/2 pints of this product per acre as a broadcast spray or as a 3/4 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.
12. **Johnsongrass / Bluegrass, Kentucky / Bromegrass, smooth / Canarygrass, reed / Orchardgrass / Ryegrass, perennial / Timothy / Wheatgrass, western:** Apply 3 to 4 1/2 pints of this product per acre as a broadcast spray or as a 3/4 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.
13. **Lantana:** Apply this product as a 3/4 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.
14. **Loosestrife, purple:** Apply 4 pints of this product per acre as a broadcast spray or as a 1 to 1 1/2 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.

15. **Lotus, American:** Apply 4 pints of this product per acre as a broadcast spray or as a 3/4 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.
16. **Maidencane / Paragrass:** Apply 6 pints of this product per acre as a broadcast spray or as a 3/4 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.
17. **Milkweed, common:** Apply 4 1/2 pints of this product per acre as a broadcast spray or as a 1 1/2 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.
18. **Nutsedge: purple, yellow:** Apply 4 1/2 pints of this product per acre as a broadcast spray, or as a 3/4 percent solution with hand-held equipment to control existing nutsedge plants and immature nutlets attached to treated plants. Apply when target plants are in flower or when new nutlets can be found at rhizome tips. Nutlets which have not germinated will not be controlled and may germinate following treatment. Repeat treatments will be required for long-term control.
19. **Pampasgrass:** Apply a 1 1/2 percent solution of this product with hand-held equipment when plants are actively growing.
20. **Phragmites:** For partial control of phragmites in Florida and the counties of other states bordering the Gulf of Mexico, apply 7 1/2 pints per acre as a broadcast spray or apply a 1 1/2 percent solution with hand-held equipment. In other areas of the U.S., apply 4 to 6 pints per acre as a broadcast spray or apply a 3/4 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.
21. **Quackgrass / Kikuyugrass / Muhly, wirestern:** Apply 3 to 4 1/2 pints of this product per acre as a broadcast spray or as a 3/4 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.
22. **Reed, giant / ice plant:** For control of giant reed and ice plant, apply a 1 1/2 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.
23. **Spatterdock:** Apply 6 pints of this product per acre as a broadcast spray or as a 3/4 percent solution with hand-held equipment. Apply when most plants are in full bloom. For best results, apply during the summer or fall months.
24. **Sweet potato, wild:** Apply this product as a 1 1/2 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 recommended stage of growth before retreatment.
25. **Thistle, Canada / artichoke:** Apply 3 to 4 1/2 pints of this product per acre as a broadcast spray or as a 1 1/2 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.
26. **Torpedograss:** Apply 6 to 7 1/2 pints of this product per acre as a broadcast spray or as a 3/4 to 1 1/2 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.
27. **Tules, common:** Apply this product as a 1 1/2 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.
28. **Waterhyacinth:** Apply 5 to 6 pints of this product per acre as a broadcast spray or apply a 3/4 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.
29. **Waterlettuce:** For control, apply a 3/4 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.
30. **Waterprimrose:** Apply this product as a 3/4 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.
31. **Other perennial weeds listed above:** Apply 4 1/2 to 7 1/2 pints of this product per acre as a broadcast spray or apply as a 3/4 to 1 1/2 percent solution with hand-held equipment.

Woody Brush and Trees

NOTE: If brush has been mowed or tilled or trees have been cut, do not treat until regrowth has reached the recommended stage of growth.

Application Rates and Timing
When applied as a 5 to 8 percent solution as a directed application as described in the “Hand-Held and High-Volume Equipment” section, this product will control or partially control all wood brush and tree species listed in this section of this label. Use the higher rate of application for dense stands and larger woody brush and trees.

Specific Brush or Tree Control Recommendations: Numbers in parentheses “(-)” following the common name of a listed brush or tree species refer to “Specific Brush or Tree Control Recommendations” which follow the species listing. See this section for specific application rates and timing for listed species.

For woody brush and trees, apply the recommended rate plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient. Use of this product without surfactant will result in reduced herbicide performance. Refer to the “Mixing and Application Instructions” section of this label and the surfactant manufacturer label for more information. Make applications when plants are actively growing and, unless otherwise directed, after full-leaf expansion. 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 application is made in the spring or early summer when brush species are at high moisture content and are flowering. Ensure thorough coverage when using hand-held equipment. 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.

See the "Directions for Use" and "Mixing and Application Instructions" sections in this label for labeled use and specific application instructions. **When applied as directed, this product plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient will control the following woody brush plants and trees:** (Numbers in parentheses "(-)" following common name of a listed brush or tree species refer to "Specific Brush or Tree Control Recommendations" for that species which follow the species listing.)

Common Name	Scientific Name
Alder (1)	*Alnus spp.*
Ash † (20)	*Fraxinus spp.*
Aspen, quaking (2)	*Populus tremuloides*
Bearclover, Bearmat (20)	*Chamaebatia foliolosa*
Birch (3)	*Betula spp.*
Blackberry (1)	*Rubus spp.*
Broom, French (4)	*Cytisus monspessulanus*
Broom, Scotch (4)	*Cytisus scoparius*
Buckwheat, California † (5)	*Eriogonum fasciculatum*
Cascara † (20)	*Rhamnus purshiana*
Catsclaw † (6)	*Acacia greggi*
Ceanothus (20)	*Ceanothus spp.*
Chamise (17)	*Adenostoma fasciculatum*
Cherry, bitter (7)	*Prunus emarginata*
Cherry, black (7)	*Prunus serotina*
Cherry, pin (7)	*Prunus pensylvanica*
Coyote brush (8)	*Baccharis consanguinea*
Creeper, Virginia † (20)	*Parthenocissus quinquefolia*
Dewberry (1)	*Rubus trivialis*
Dogwood (9)	*Cornus spp.*
Elderberry (3)	*Sambucus spp.*
Elm † (20)	*Ulmus spp.*
Eucalyptus, bluegum (10)	*Eucalyptus globulus*
Hasardia † (5)	*Haplopappus squamosus*
Hawthorn (2)	*Crataegus spp.*
Hazel (3)	*Corylus spp.*
Hickory (9)	*Carya spp.*
Holly, Florida (11) (Brazilian peppertree)	*Schinus terebinthifolius*
Honeysuckle (1)	*Lonicera spp.*
Hornbeam, American (20)	*Carpinus caroliniana*
Kudzu (12)	*Pueraria lobata*
Locust, black † (20)	*Robinia pseudoacacia*
Manzanita (20)	*Arctostaphylos spp.*
Maple, red † (13)	*Acer rubrum*
Maple, sugar (14)	*Acer saccharum*
Maple, vine † (20)	*Acer circinatum*
Monkey flower † (5)	*Mimulus guttatus*
Oak, black † (20)	*Quercus velutina*
Oak, northern pin (14)	*Quercus palustris*
Oak, post (1)	*Quercus stellata*
Oak, red (14)	*Quercus rubra*
Oak, southern red (7)	*Quercus falcata*
Oak, white † (20)	*Quercus alba*
Persimmon † (20)	*Diospyros spp.*
Poison-ivy (15)	*Rhus radicans*
Poison-oak (15)	*Rhus toxicodendron*
Poplar, yellow † (20)	*Liriodendron tulipifera*
Prunus (7)	*Prunus spp.*
Raspberry (1)	*Rubus spp.*
Redbud, eastern (20)	*Cercis canadensis*
Rose, multiflora (16)	*Rosa multiflora*
Russian-olive (20)	*Elaeagnus angustifolia*
Sage: black (17), white	*Salvia spp.*
Sagebrush, California (17)	*Artemisia californica*
Salmonberry (3)	*Rubus spectabilis*
Salt cedar † (9)	*Tamarix spp.*
Saltbush, sea myrtle (18)	*Baccharis halimifolia*
Sassafras (20)	*Sassafras aibidum*
Sourwood † (20)	*Oxydendrum arboreum*
Sumac, poison † (20)	*Rhus vernix*
Sumac, smooth † (20)	*Rhus glabra*
Sumac, winged † (20)	*Rhus copallina*
Sweetgum (7)	*Liquidambar styraciflua*
Swordfern † (20)	*Polystichum munitum*
Tallowtree, Chinese (17)	*Sapium sebiferum*
Thimbleberry (3)	*Rubus parviflorus*
Tobacco, tree † (5)	*Nicotiana glauca*
Trumpetcreeper (2)	*Campsis radicans*
Waxmyrtle, southern † (11)	*Myrica cerifera*
Willow (19)	*Salix spp.*

† Partial control (See below for control or partial control instructions.)

Specific Brush or Tree Control Recommendations:

1. **Alder / Blackberry / Dewberry / Honeysuckle / Oak, Post / Raspberry:** For control, apply 4 1/2 to 6 pints per acre as a broadcast spray or as a 3/4 to 1 1/4 percent solution with hand-held equipment.
2. **Aspen, Quaking / Hawthorn / Trumpetcreeper:** For control, apply 3 to 4 1/4 pints of this product per acre as a broadcast spray or as a 3/4 to 1 1/4 percent solution with hand-held equipment.
3. **Birch / Elderberry / Hazel / Salmonberry / Thimbleberry:** For control, apply 3 pints per acre of this product as a broadcast spray or as a 3/4 percent solution with hand-held equipment.
4. **Broom, French / Broom, Scotch:** For control, apply a 1 1/4 to 1 1/2 percent solution with hand-held equipment.
5. **Buckwheat, California / Hasardia / Monkey flower / Tobacco, tree:** For partial control of these species, apply a 3/4 to 1 1/2 percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.
6. **Catsclaw:** For partial control, apply a 1 1/4 to 1 1/2 percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.
7. **Cherry, bitter / Cherry, black / Cherry, pin / Oak, southern red / Sweetgum / Prunus:** For control, apply 3 to 7 1/2 pints of this product per acre as a broadcast spray or as a 1 to 1 1/2 percent solution with hand-held equipment.
8. **Coyote brush:** For control, apply a 1 1/4 to 1 1/2 percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

9. **Dogwood / Hickory / Salt cedar:** For partial control, apply a 1 to 2 percent solution of this product with hand-held equipment or 6 to 7 1/2 pints per acre as a broadcast spray.
10. **Eucalyptus, bluegum:** For control of eucalyptus resprouts, apply a 1 1/2 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.
11. **Holly, Florida / Waxmyrtle, southern:** For partial control, apply this product as a 1 1/2 percent solution with hand-held equipment.
12. **Kudzu:** For control, apply 6 pints of this product per acre as a broadcast spray or as a 1 1/2 percent solution with hand-held equipment. Repeat applications will be required to maintain control.
13. **Maple, red:** For control, apply as a 3/4 to 1 1/4 percent solution with hand-held equipment when leaves are fully developed. For partial control, apply 2 to 7 1/2 pints of this product per acre as a broadcast spray.
14. **Maple, sugar / Oak: northern pin / Oak, red:** For control, apply as a 3/4 to 1 1/4 percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.
15. **Poison-ivy / Poison-oak:** For control, apply 6 to 7 1/2 pints of this product per acre as a broadcast spray or as a 1 1/2 percent solution with hand-held equipment. Repeat applications may be required to maintain control. Fall treatments must be applied before leaves lose green color.
16. **Rose, multiflora:** For control, apply 3 pints of this product per acre as a broadcast spray or as a 3/4 percent solution with hand-held equipment. Treatments should be made prior to leaf deterioration by leaf-feeding insects.
17. **Sage, black / Sagebrush, California / Chamise / Tallowtree, Chinese:** For control of these species, apply a 3/4 percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.
18. **Saltbush, sea myrtle:** For control, apply this product as a 1 percent solution with hand-held equipment.
19. **Willow:** For control, apply 4 1/2 pints of this product per acre as a broadcast spray or as a 3/4 percent solution with hand-held equipment.
20. **Other woody brush and trees listed above:** For partial control, apply 3 to 7 1/2 pints of this product per acre as a broadcast spray or as a 3/4 to 1 1/2 percent solution with hand-held equipment.

Aquatic and other Noncrop Sites

Apply this product as directed and under conditions described to control or partially control weeds and woody plants listed in the “Weeds Controlled” section in industrial, recreational and public areas or other similar aquatic or terrestrial sites on this label.

Noncrop Sites

This product may be used to control the listed weeds in and around aquatic sites and on noncrop sites such as :

Airports
Golf Courses
Habitat Restoration & Management Areas
Highways & Roadsides
Industrial Plant Sites
Lumberyards
Parking Areas
Parks
Petroleum Tank Farms
Pipeline, Power, Telephone & Utility Rights-of-Way
Pumping Installations
Railroads
Schools
Storage Areas
Similar Sites

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 and similar sites.

If aquatic sites are present in the noncrop 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 1/2 mile upstream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within 1/2 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 1/2 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 re-treat 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 1/2 pints per acre must not be exceeded in any single broadcast application that is being made over water.

- 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.

Forestry Sites and Utility Rights-of-Way

In forest and utility sites, this product is recommended for the control or partial control of woody brush, trees, and annual and perennial herbaceous weeds. This product is also recommended for use in preparing or establishing wildlife openings within these sites, in pine straw plantations for maintaining logging roads, and for side trimming along utility rights-of-way.

In forestry sites, this product is recommended for use in site preparation prior to planting any tree species, including Christmas trees and silvicultural nursery sites.

In utility sites, this product is recommended for use along electrical power, pipeline, and telephone rights-of-way, and in other utility sites associated with these rights-of-way, such as substations.

Application Rates [†]:

Method of Application	Application Rate	Spray Volume (gal/acre)
Broadcast		
Aerial	1.5 to 7.5 qt/acre	5 to 30
Ground	1.5 to 7.5 qt/acre	10 to 60
Spray-to-Wet		
Handgun, Backpack Mistblower	0.75 to 2% by volume	spray-to-wet
Low Volume Directed Spray [††] Handgun, Backpack Mistblower	5% to 10% by volume	partial coverage

[†] Where repeat applications are necessary, do not exceed 8.0 quarts per acre per year.

[††] For low volume directed spray applications, coverage should be uniform with at least 50 percent of the foliage contacted. For best results, coverage of the top one-half of the plant is important.

In forestry site preparation and utility rights-of-way applications, this product requires use with a surfactant such as a non-ionic surfactant containing greater than 80 percent active ingredient. Use of this product without surfactant will result in reduced herbicideperformance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information.

Use higher rates of this product within the recommended rate ranges for control or partial control of woody brush, trees and hard-to-control perennial herbaceous weeds. For best results, apply to actively growing woody brush and trees after full leaf expansion and before fall color and leaf drop. Use increased rates within the recommended rate range to control of perennial herbaceous weeds from emergence up to the appearance of seedheads, flowers or berries appear. Use lower rates within the recommended rate range to control annual herbaceous weeds and actively growing perennial herbaceous weeds after seedheads, flowers or berries appear. Apply to foliage of actively growing annual herbaceous weeds anytime after emergence.

Tank Mixtures

This product may be used in tank mix combination with other herbicide products to broaden the spectrum of vegetation controlled. When tank mixing, read and observe applicable use directions, precautions and limitations on the respective product labels. Use according to the most restrictive precautionary statements for each product on the mixture. Any recommended rate of this product may be used in a tank mix.

Note: For forestry site preparation, make sure the tank mix product is approved for use prior to planting the desired species. Observe planting interval restrictions. For side trimming treatments in utility rights-of-way, tank mixtures with Arsenal 2WSL herbicide are not recommended. For side trimming treatments, it is recommended that this product be used alone as recommended, or as a tank mix with Garlon.

Product	Broadcast Rate	Use Sites
Arsenal Applicators Concentrate	2 to 16 fl oz/acre	Forestry site preparation
Oust	1 to 4 oz/acre	Forestry site preparation, utility sites
Garlon 3A [†]	1 to 4 qt/acre	Forestry site preparation, utility sites
Garlon 4	1 to 4 qt/acre	Forestry site preparation, utility sites
Arsenal 2WSL	2 to 32 fl oz/acre	Utility sites
	Spray-to-Wet Rates	
Arsenal Applicators Concentrate	1/32% to 1/2% by volume	Forestry site preparation
Arsenal 2WSL	1/32% to 1/2% by volume	Utility sites
	Low Volume Directed Spray Rates	
Arsenal Applicators Concentrate	1/8% to 1/2% by volume	Forestry site preparation
Arsenal 2WSL	1/8% to 1/2% by volume	Utility sites

[†] Ensure that Garlon 3A is thoroughly mixed with water before adding this product. Agitation is required while mixing this product with Garlon 3A to avoid compatibility problems.

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

Forestry Conifer and Hardwood Release

Directed Sprays and Selective Equipment

This product may be applied as a directed spray or by using selective equipment in forestry conifer and hardwood sites, including Christmas tree plantations and silvicultural nurseries. This product requires use with a surfactant. Use only surfactants that are approved for conifer release and specified on the surfactant label as safe for use in conifer release (pine release). Use of this product without surfactant will result in reduced herbicide performance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information.

Tank Mixing: In hardwood plantations, tank mixtures with Oust may be used. In pine plantations, tank mixtures with Garlon 4 or Arsenal AC may be used. Comply with all site restrictions, forestry species limitations, and precautions on the tank mix product labels.

Avoid contact of spray drift, mist or drips with foliage, green bark or non-woody surface roots of desirable plant species. See "Application Equipment and Techniques" section of this label for specific recommendations and precautions.

Spray-to-Wet Applications: Use a 2 percent spray solution to control undesirable woody brush and trees. To control herbaceous weeds, use a 1 to 2 percent spray solution.

Low Volume Directed Spray Applications: Use a 5 to 10 percent spray solution. Coverage should be uniform with at least 50 percent of the foliage contacted. Coverage of the top one-half of the unwanted vegetation is important.

Broadcast Applications: For equipment calibrated for broadcast applications, use 1 1/2 to 7 1/2 quarts of this product per acre. Apply in 10 to 60 gallons of clean water per acre. Shielded application equipment may be used to avoid contact of the spray solution with desirable plants. Shields should be adjusted to prevent spray contact with the foliage of green bark of desirable vegetation.

Wiper Application Equipment: See the "Selective Equipment" section of this label for equipment and application rate recommendations.

Broadcast Application

Note: Except where specifically recommended below, make broadcast applications of this product only where conifers have been established for more than one year.

Broadcast application must be made after formation of final conifer resting buds in the fall or prior to initial bud swelling in the spring.

Injury may occur to conifers treated for release, especially where spray patterns overlap or the higher rates are applied. Damage can be accentuated if applications are made when conifers are actively growing, or are under stress from drought, flood water, improper planting, insects, animal damage or diseases.

This product requires use with a surfactant. Use a surfactant that is labeled/recommended for use in over-the-top release applications. Use of this product without a surfactant will result in reduced herbicide performance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information.

For release of the following conifer species outside the Southeastern United States:

Douglas fir (*Pseudotsuga menziesii*)
Fir (*Abies* species)
Hemlock [††] (*Tsuga* species)
Pines [†] (*Pinus* species)
Redwood, California [††] (*Sequoia* species)

[†] Includes all species except loblolly pine, longleaf pine, shortleaf pine or slash pine.

[††] Use of a surfactant is not recommended for release of hemlock species or California redwood. In mixed conifer stands, injury to these species may result if a surfactant is used.

Application Rate for Conifer Release: Apply 3/4 to 1 1/2 quarts per acre as a broadcast spray. In Maine and New Hampshire, up to 2 1/4 quarts per acre of this product may be used for the control and suppression of difficult-to-control hardwood species.

To release Douglas fir, and pine and spruce species at the end of the first growing season (except in California), apply 3/4 to 1 1/8 quarts per acre of this product. Make sure that all conifers are well hardened off.

Note: For release of Douglas fir with this product or recommended tank mixtures, a nonionic surfactant recommended for over-the-top foliar spray may be used. To avoid possible conifer injury, nonionic surfactants may be used at 2 fluid ounces per acre at elevations above 1500 feet, or 1 fluid ounce per acre in the coastal range or at elevations below 1500 feet. Use of surfactant rates exceeding those listed above may result in unacceptable conifer injury and are not recommended. Make sure that the nonionic surfactant has been adequately tested for safety to Douglas fir before use.

Tank Mixtures with Oust: To release jack pine, white pine and white spruce, apply 3/4 to 1 1/2 quarts of this product with 1 to 3 ounces (1 to 1 1/2 ounces for white pine) of Oust per acre. Make applications to actively growing weeds as a broadcast spray over the top of established conifers. Applications at these rates should be made after formation of conifer resting buds in the late summer or fall.

Tank Mixtures with Arsenal Applicators Concentrate: This product may be tank mixed with Arsenal Applicators Concentrate for release of Douglas fir. Tank mix 3/4 to 1 1/8 quarts of this product with 2 to 6 fluid ounces of Arsenal Applicators Concentrate per acre. For release of balsam fir and red spruce, apply a mixture of 1 1/2 quarts of this product with 1 to 2 1/2 fluid ounces of Arsenal Applicators Concentrate per acre.

In Maine and New Hampshire for the release of red pine, balsam fir, red spruce, white spruce, Norway spruce, and black spruce with dense tough-to-control brush and where maples make up a large component of the undesirable trees, up to 2 1/4 quarts per acre of this product may be tank mixed with 1 to 2 1/2 fluid ounces per acre of Arsenal Applicators Concentrate herbicide and applied as a broadcast spray.

Tank mixtures with Arsenal Applicators Concentrate and Oust or Oust XP Herbicides: In Maine and New Hampshire for release of red pine, balsam fir, red spruce, white spruce, Norway spruce and black spruce with heavy grass and herbaceous weed densities, tough-to-control brush and where maples make up a large component of the undesirable trees up to 2 1/4 quarts per acre of this product may be tank mixed with 1 to 2.5 fluid ounces per acre of Arsenal Applicators Concentrate and 1 to 3 oz of Oust or Oust XP herbicides and applied as a broadcast spray.

For release of the following conifer species in the Southeastern United States:

Loblolly pine (*Pinus taeda*)
Eastern white pine (*Pinus strobus*)
Shortleaf pine (*Pinus echinata*)
Slash pine (*Pinus elliottii*)
Virginia pine (*Pinus virginiana*)
Longleaf pine (*Pinus palustris*)

Apply 1 1/8 to 1 7/8 quarts of this product per acre as a broadcast spray during late summer or early fall after the conifers have hardened off. For applications at the end of the first growing season, use 3/4 quart of this product alone or in a recommended tank mixture.

Tank Mixtures with Arsenal Applicators Concentrate: For conifer release, apply 3/4 to 1 1/2 quarts of this product with 2 to 16 fluid ounces of Arsenal Applicators Concentrate per acre as a broadcast spray. Use only on conifer species that are labeled for over-the-top spray for both products. Use the higher recommended rates for dense tough-to-control wood brush and trees.

Read and observe label claims, cautionary statements and all information on the labels of each product used in these tank mixtures. Use according to the most restrictive precautionary statements for each product in the mixture.

Herbaceous Release

When applied as directed, this product plus listed residual herbicides provides postemergence control of the annual weeds and control or suppression of the perennial weeds listed in this label, and residual control of the weeds listed in the residual herbicide label. Make applications to actively growing weeds as a broadcast spray over the top of labeled conifers.

Tank Mixtures with Oust: To release loblolly pines, tank mix 12 to 18 fluid ounces of this product with 2 to 4 ounces of Oust per acre.

To release slash pines, tank mix 9 to 12 fluid ounces of this product with 2 to 4 ounces of Oust per acre.

In Maine and New Hampshire for release of red pine, balsam fir, red spruce, white spruce, Norway spruce, and black spruce with heavy grass and herbaceous weeds infesting the site, up to 2 1/4 quarts per acre of this product may be tank mixed with 1 to 3 oz of Oust herbicide or Oust XP herbicide to control grass, herbaceous weeds and woody brush, and applied as a broadcast spray.

For tank mixtures with Oust use a surfactant that is labeled/ recommended for use in over-the-top herbaceous release applications. Use of this product without a surfactant will result in reduced herbicide performance. Refer to the “Mixing and Application Instructions” section of this label and the surfactant manufacturer label for more information.

Weed control may be reduced if water volumes exceed 25 gallons per acre for these treatments.

Tank Mixture with Atrazine: To release Douglas fir, apply 3/4 quart of this product with 4 pounds a.i. of atrazine per acre. Apply only over Douglas fir that has been established for at least one full growing season. Apply in the early spring, usually mid-March through early April. Injury will occur if applications are made after bud swell in the spring. For this use, do not add surfactant to the tank mixture.

Always read and follow the manufacturer’s label for all herbicides and surfactants used.

Wetland Sites

This product may be used in and around water (aquatic areas) and wetlands found in forestry and in power, telephone and pipeline rights-of-way sites, including where these sites are adjacent to or surrounding domestic water supply reservoirs, supply streams, lakes and ponds. Read and observe the following before making applications in and around water.

Consult local public water control authorities before applying this product in and around public water. Permits may be required to treat in such areas.

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

Note: Do not apply this product directly to water within 1/2 mile up-stream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within 1/2 mile of an active potable water intake in a standing body of water such as a lake, pond or reservoir. To make aquatic applications around and within 1/2 mile of active potable water intakes, the water intake must be turned off for a minimum period of 48 hours after application. 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 application. This restriction does not apply to intermittent inadvertent overspray of water in terrestrial use sites.

Do not spray open bodies of water where woody brush, trees and herbaceous weeds do not exist. The maximum application rate of 3 3/4 quarts per acre must not be exceeded in a single over-water broadcast application except as follows, where any recommended rate may be applied:

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

Wildlife Habitat Restoration and Management Areas

This product is recommended for the restoration and/or maintenance of native habitat and in wildlife management areas.

Habitat Restoration and Maintenance: When applied as directed, exotic and other undesirable vegetation may be controlled in habitat management areas. Applications may be made to allow recovery of native plant species, to open up water to attract waterfowl, and for similar broad-spectrum vegetation control requirements in habitat management areas. Spot treatments may be made to selectively remove unwanted plants for habitat enhancement. For spot treatments, care should be exercised to keep spray off of desirable plants.

Wildlife Food Plots: This product may be used as a site preparation treatment prior to planting wildlife food plots. Apply as directed to control vegetation in the plot area. Any wildlife food species may be planted after applying this product, or native species may be allowed to reinfest the area. If tillage is needed to prepare a seedbed, wait 7 days after applying this product before tilling to allow for maximum effectiveness.

Wiper Applications

For wick or wiper applications, mix 1 gallon of this product with 2 gallons of clean water to make a 33 percent solution. Addition of a nonionic surfactant at a rate of 10 percent by volume of total herbicide solution is recommended.

Wiper applications can be used to control or suppress annual and perennial weeds listed on this label. In heavy weed stands, a double application in opposite directions may improve results. See the "Weed Controlled" section in this label for recommended timing, growth stage and other instructions for achieving optimum results

Cut Stump Application

Woody vegetation may be controlled by treating freshly cut stumps of trees and resprouts with this product. Apply this product using suitable equipment to ensure coverage of the entire cambium. Cut vegetation close to the soil surface. **Apply a 50 to 100 percent solution of this product to freshly cut surface immediately after cutting.** Delay in applying this product may result in reduced performance. For best results, trees should be cut during periods of active growth and full leaf expansion.

When used according to directions for cut stump application, this product will **control**, **partially control or suppress** most woody brush and tree species, some of which are listed below:

Common Name	**Scientific Name**
Alder	*Alnus spp.*
Coyote brush †	*Baccharis consanguinea*
Dogwood †	*Cornus spp.*
Eucalyptus	*Eucalyptus spp.*
Hickory †	*Carya spp.*
Madrone	*Arbutus menziesii*
Maple †	*Acer spp.*
Oak	*Quercus spp.*
Poplar †	*Populus spp.*
Reed, giant	*Arundo donax*
Salt cedar	*Tamarix spp.*
Sweet gum †	*Liquidambar styraciflua*
Sycamore †	*Platanus occidentalis*
Tan oak	*Lithocarpus densiflorus*
Willow	*Salix spp.*

† This product is not approved for this use on these species in the state of California.

Injection and Frill Applications

Woody vegetation may be controlled by injection or frill application of this product. Apply this product using suitable equipment which must penetrate into living tissue. Apply the equivalent of 1 ml of this product per 2 to 3 inches of trunk diameter. This is best achieved by applying 25 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 dilute material to a continuous frill or more closely spaced cuttings. Avoid application techniques that allow runoff to occur from frill or cut areas in species that exude sap freely after frills or cutting. In species such as these, make frill or cut at an oblique angle so as to produce a cupping effect and use undiluted material. For best results, applications should be made during periods of active growth and full leaf expansion.

This treatment will control the following woody species:

Common Name	**Scientific Name**
Oak	*Quercus spp.*
Poplar	*Populus spp.*
Sweet gum	*Liquidambar styraciflua*
Sycamore	*Platanus occidentalis*

This treatment will suppress the following woody species:

Common Name	**Scientific Name**
Black gum †	*Nyssa sylvatica*
Dogwood	*Cornus spp.*
Hickory	*Carya spp.*
Maple, red	*Acer rubrum*

†This product is not approved for this use on this species in the state of California.

Release of Bermudagrass or Bahiagrass on Noncrop Sites

Release Of Dormant Bermudagrass And Bahiagrass

When applied as directed, this product will provide control or suppression of many winter annual weeds and tall fescue for effective release of dormant bermudagrass or bahiagrass. Make applications to dormant bermudagrass or bahiagrass.

For best results on winter annuals, treat when weeds 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 in or beyond the 4 to 6-leaf stage.

Weeds Controlled

Rate recommendations for control or suppression of winter annuals and tall fescue are listed below.

Apply the recommended rates of this product in 10 to 25 gallons of water per acre plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient.. Use of this product without surfactant will result in reduced herbicide performance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information.

Weeds Controlled or Suppressed †

Note: C = Controlled; S = Suppressed

	Rate (Fluid Ounces Per Acre)					
Weed Species	**6**	**9**	**12**	**18**	**24**	**48**
Barley, little *Hordeum pusillum*	S	C	C	C	C	C
Bedstraw, catchweed *Galium aparine*	S	C	C	C	C	C
Bluegrass, annual *Poa annua*	S	C	C	C	C	C
Chervil *Chaerophyllum tainturieri*	S	C	C	C	C	C
Chickweed, common *Stellaria media*	S	C	C	C	C	
Clover, crimson *Trifolium incarnatum*	•	S	S	C	C	C
Clover, large hop *Trifolium campestre*	•	S	S	C	C	C
Speedwell, corn *Veronica arvensis*	S	C	C	C	C	C
Fescue, tall *Festuca arundinacea*	•	•	•	•	S	S
Geranium, Carolina *Geranium carolinianum*	•	•	S	S	C	C
Henbit *Lamium amplexicaule*	•	S	C	C	C	C
Ryegrass, Italian *Lolium multiflorum*	•	•	S	C	C	C
Vetch, common *Vicia sativa*	•	•	S	C	C	C

† These rates apply only to sites where an established competitive turf is present.

Release Of Actively Growing Bermudagrass

NOTE: Use only on sites where bahiagrass or bermudagrass are desired for ground cover and some temporary injury or yellowing of the grasses can be tolerated.

When applied as directed, this product will aid in the release of bermudagrass by providing control of annual species listed in the "Weeds Controlled" section in this label, and suppression or partial control of certain perennial weeds.

For control or suppression of those annual species listed in this label, use 3/4 to 2 1/4 pints of this product as a broadcast spray in 10 to 25 gallons of spray solution per acre, plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient.. Use of this product without surfactant will result in reduced herbicide performance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information. Use the lower rate when treating annual weeds below 6 inches in height (or length of runner in annual vines). Use the higher rate as size of plants increases or as they approach flower or seedhead formation.

Use the higher rate for partial control or longer-term suppression of the following perennial species. Use lower rates for shorter-term suppression of growth.

Bahiagrass	Johnsongrass †
Dallisgrass	Trumpetcreeper ††
Fescue (tall)	Vaseygrass

† Johnsongrass is controlled at the higher rate.
†† Suppression at the higher rate only.

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

Bahiagrass Seedhead and Vegetative Suppression

When applied as directed in the "Noncrop Sites" section in this label, this product will provide significant inhibition of seedhead emergence and will suppress vegetative growth for a period of approximately 45 days with single applications and approximately 120 days with sequential applications.

Apply this product 1 to 2 weeks after full green-up of bahiagrass or after the bahiagrass has been mowed to a uniform height of 3 to 4 inches. Applications must be made prior to seedhead emergence. Apply 5 fluid ounces per acre of this product in 10 to 25 gallons of water per acre, plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient.. Use of this product without surfactant will result in reduced herbicide performance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information.

Sequential applications of this product plus nonionic surfactant may be made at approximately 45-day intervals to extend the period of seedhead and vegetative growth suppression. For continued vegetative growth suppression, sequential applications must be made prior to seedhead emergence.

Apply no more than 2 sequential applications per year. As a first sequential application, apply 3 fluid ounces of this product per acre plus nonionic surfactant. A second sequential application of 2 to 3 fluid ounces per acre plus nonionic surfactant may be made approximately 45 days after the last application.

Annual Grass Growth Suppression

For growth suppression of some annual grasses, such as annual ryegrass, wild barley and wild oats growing in coarse turf on roadsides or other industrial areas, apply 3 to 4 ounces of this product in 10 to 40 gallons of water per acre plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient.. Use of this product without surfactant will result in reduced herbicide performance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information. . Applications should be made when annual grasses are actively growing and before the seedheads are in the boot stage of development. Treatments made after seedhead emergence may cause injury to the desired grasses.

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.

Inherent Risks of Use

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 fullest extent permitted by law, all such risks shall be assumed by buyer.

Limitation of Remedies

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. To the fullest 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 above 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.

Produced for
Dow AgroSciences LLC
9330 Zionsville Road
Indianapolis, IN 46268

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Replaces Label: D02-148-004
LOES Number: 010-01471

EPA-accepted 07/13/06

Revisions:

1. Updated Storage and Disposal

Appendix C.

Example Imazapyr Herbicide Label

Habitat®

herbicide

Applications may only be made for the control of undesirable emergent and floating aquatic vegetation in and around standing and flowing water, including estuarine and marine sites. Applications may be made to control undesirable wetland, riparian and terrestrial vegetation growing in or around surface water when applications may result in inadvertent applications to surface water.

Active ingredient:	
Isopropylamine salt of Imazapyr (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid)*	28.7%
Inert ingredients	71.3%
Total	100.0%

* Equivalent to 22.6% 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid or 2 pounds acid per gallon.

EPA Reg. No. 241-426 **U.S. Patent No. 4,798,619** **EPA Est. No.**

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.)

In case of an emergency endangering life or property involving this product, call day or night, 800-832-HELP.

See Next Page for Additional Precautionary Statements

Net contents: _____

BASF Corporation
26 Davis Drive
Research Triangle Park, NC 27709

BASF
The Chemical Company

FIRST AID	
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 in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
If inhaled	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. • Call a poison control center or doctor for further treatment advice.
HOT LINE NUMBER	
Have the product container or label with you when calling a poison control center or doctor or going for treatment. You may also contact BASF Corporation for emergency medical treatment information: 1-800-832-HELP (4357).	

PRECAUTIONARY STATEMENTS

HAZARD TO HUMANS
CAUTION!

Avoid contact with skin, eyes or clothing. Avoid breathing spray mist. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT (PPE):

Some materials that are chemical-resistant to this product are listed below. If you want more options, follow the instructions for category A on an EPA chemical-resistant category selection chart.

Applicators and other handlers must wear:

- Long-sleeve shirt and long pants
- Chemical-resistant gloves, Category A
- shoes plus socks

Follow manufacturer's instructions for cleaning and maintaining PPE. If no such instructions are given for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

PHYSICAL AND CHEMICAL HAZARDS

Spray solutions of **HABITAT® herbicide** should be mixed, stored and applied only in stainless steel, fiberglass, plastic and plastic-lined steel containers.

DO NOT mix, store or apply **HABITAT** or spray solutions of **HABITAT** in unlined steel (except stainless steel) containers or spray tanks.

ENVIRONMENTAL HAZARDS

DO NOT apply to water except as specified in this label. Treatment of aquatic weeds may result in oxygen depletion or loss due to decomposition of dead plants. This oxygen loss may cause the suffocation of some aquatic organisms. Do not treat more than one half of the surface area of the water in a single operation and wait at least 10 to 14 days between treatments. Begin treatment along the shore and proceed outward in bands to allow aquatic organisms to move into untreated areas. Do not contaminate water when disposing of equipment washwaters or rinsate.

This pesticide is toxic to vascular plants and should be used strictly in accordance with the drift precautions on the label.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

HABITAT should be used only in accordance with recommendations on the leaflet label attached to the container. Keep containers closed to avoid spills and contamination.

STORAGE AND DISPOSAL

DO NOT contaminate water, food or feed by storage or disposal.

PESTICIDE STORAGE: DO NOT store below 10° F.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL:
Nonrefillable Container. DO NOT reuse or refill this container. Triple rinse or pressure rinse container (or equivalent) promptly after emptying; then offer for recycling, if available, or reconditioning, if appropriate, or puncture and dispose of in a sanitary landfill, or by incineration, or by other procedures approved by state and local authorities.

Triple rinse containers small enough to shake (capacity ≤ 5 gallons) 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.

Triple rinse containers too large to shake (capacity > 5 gallons) 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. 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 mix tank. 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.

IMPORTANT

DO NOT use on food crops. **DO NOT** apply this product within one-half mile upstream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within one-half mile of an active potable water intake in a standing body of water, such as a lake, pond or reservoir. **DO NOT** apply to water used for irrigation

except as described in **APPLICATION TO WATERS USED FOR IRRIGATION** section of this label. Keep from contact with fertilizers, insecticides, fungicides and seeds. **DO NOT** drain or flush equipment on or near desirable trees or other plants, or on areas where their roots may extend, or in locations where the treated soil may be washed or moved into contact with their roots. **DO NOT** use on lawns, walks, driveways, tennis courts, or similar areas. **DO NOT** side trim desirable vegetation with this product unless severe injury and plant death can be tolerated. Prevent drift of spray to desirable plants.

Clean application equipment after using this product by thoroughly flushing with water.

GENERAL USE PRECAUTIONS AND RESTRICTIONS

Applications may only be made for the control of undesirable emergent and floating aquatic vegetation in and around standing and flowing water, including estuarine and marine sites. Applications may be made to control undesirable wetland, riparian and terrestrial vegetation growing in or around surface water when applications may result in inadvertent applications to surface water.

Do not apply more than 6 pints of product (1.5 lbs. acid equivalent) per acre per year.

Aerial application is restricted to helicopter only.

Application of **HABITAT® herbicide** can only be made by federal or state agencies, such as Water Management District personnel, municipal officials and the U.S. Army Corps of Engineers, or those applicators who are licensed or certified as aquatic pest control applicators and are authorized by the state or local government.

Treatment to other than non-native invasive species is limited to only those plants that have been determined to be a nuisance by a federal or state government entity.

Applications to private waters: Applications may be made to private waters that are still, such as ponds, lakes and drainage ditches where there is minimal or no outflow to public waters.

Application to public waters: Applications may be made to public waters such as ponds, lakes, reservoirs, marshes, bayous, drainage ditches, canals, streams, rivers, and other slow-moving or quiescent bodies of water for control of aquatic weeds or for control of riparian and wetland weed species.

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.

Recreational Use of Water in Treatment Area: There are no restrictions on the use of water in the treatment area for recreational purposes, including swimming and fishing.

Livestock Use of Water in/from Treatment Area: There are no restrictions on livestock consumption of water from the treatment area.

Precautions for Potable Water Intakes: Do not apply **HABITAT** directly to water within one-half mile upstream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within one-half 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 one-half mile of active potable water intakes, the water intake must be turned off during application and for a minimum of 48 hours after the application. These aquatic applications may be made only in the 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. Note: Existing potable water intakes which are no longer in use, such as those replaced by connections to wells or a municipal water system, are not considered to be active potable water intakes. This restriction does not apply to intermittent, inadvertent overspray of water in terrestrial use sites.

APPLICATION TO WATERS USED FOR IRRIGATION

Water treated with **HABITAT** may not be used for irrigation purposes for 120 days after application or until **HABITAT** residue levels are determined by laboratory analysis, or other appropriate means of analysis, to be 1.0 ppb or less.

Seasonal Irrigation Waters: HABITAT 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 **HABITAT** application and the first use of treated water for irrigation purposes or until **HABITAT** 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 **HABITAT** to irrigation canals/ditches unless the 120-day restriction on irrigation water usage can be observed or **HABITAT** residue levels are determined by laboratory analysis, or other appropriate means of analysis, to be 1.0 ppb or less. DO NOT apply **HABITAT** to dry irrigation canals/ditches.

Quiescent or Slow Moving Waters: In lakes and reservoirs DO NOT apply **HABITAT** within one (1) mile of an active irrigation water intake during the irrigation season. Applications less than one (1) mile from an inactive irrigation water intake may be made during the off-season, provided that the irrigation intake will remain inactive for a minimum 120 days after application or until **HABITAT** residue levels are determined by laboratory analysis, or other appropriate means of analysis, to be 1.0 ppb or less.

Moving water: DO NOT apply within one-half mile downstream of an active irrigation water intake. When making applications upstream from an active irrigation water intake, the intake must be turned off for a period of time sufficient to allow the upstream portion of treated water to completely flow past the irrigation intake before use can resume. Shut off time will be determined by the speed of water flow and the distance and length of water treated upstream from the intake. Consult local, state and/or federal authorities before making any applications upstream from an active irrigation water intake.

GENERAL INFORMATION

Use Sites: HABITAT is an aqueous solution to be mixed with water and a surfactant and applied as a spray solution to control floating and emergent undesirable vegetation (see **AQUATIC WEEDS CONTROLLED** section and the **ADDITIONAL WEEDS CONTROLLED BY HABITAT** section) in or near bodies of water which may be flowing, non-flowing, or transient. **HABITAT** may be applied to aquatic sites that include lakes, rivers, streams, ponds, seeps, drainage ditches, canals, reservoirs, swamps, bogs, marshes, estuaries, bays, brackish water, transitional areas between terrestrial and aquatic sites and seasonal wet areas. See **AQUATIC USE** section of this label for precautions, restrictions, and instructions on aquatic uses.

Read and observe the following directions if aquatic sites are present in terrestrial noncrop areas and are part of the intended treatment area:

Herbicidal Activity: HABITAT will control most annual and perennial grasses and broadleaf weeds in addition to many brush and vine species with some residual control of undesirable species that germinate above the waterline. **HABITAT** is readily absorbed through emergent leaves and stems and is translocated rapidly throughout the plant, with accumulation in the meristematic regions. Treated plants stop growing soon after spray application. Chlorosis appears first in the newest leaves, and necrosis spreads from this point. In perennials, the herbicide is translocated into, and kills, underground or submerged storage organs, which

prevents regrowth. Chlorosis and tissue necrosis may not be apparent in some plant species until two or more weeks after application. Complete kill of plants may not occur for several weeks. Applications of **HABITAT® herbicide** are rainfast one hour after treatment.

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

Application Methods: HABITAT must be applied to the emergent foliage of the target vegetation and has little to no activity on submerged aquatic vegetation. **HABITAT** concentrations resulting from direct application to water are not expected to be of sufficient concentration or duration to provide control of target vegetation. Application should be made in such a way as to maximize spray interception by the target vegetation while minimizing the amount of overspray that enters the water. For maximum activity, weeds should be growing vigorously at the time of application and the spray solution should include a surfactant (See **ADJUVANTS** section for specific recommendations). **HABITAT** may be selectively applied by using low-volume directed application techniques or may be broadcast-applied by using ground equipment, watercraft or by helicopter. In addition, **HABITAT** may also be used for cut stump, cut stem and frill and girdle treatments within aquatic sites (see **AERIAL APPLICATIONS** and **GROUND APPLICATIONS** sections for additional details).

HABITAT should be applied with surface or helicopter application equipment in a minimum of 5 gallons of water per acre. When applying by helicopter, follow directions under the **AERIAL APPLICATIONS** section of this label, otherwise refer to section on **GROUND APPLICATIONS** when using surface equipment.

Applications made to moving bodies of water should be made while traveling upstream to prevent concentration of this herbicide in water. DO NOT apply to bodies of water or portions of bodies of water where emergent and/or floating weeds do not exist.

When application is to be made to target vegetation that covers a large percentage of the surface area of impounded water, treating the area in strips may avoid oxygen depletion due to decaying vegetation. Oxygen depletion may result in the suffication of some sensitive aquatic organisms. Do not treat more than one half of the surface area of the water in a single operation and wait at least 10 to 14 days between treatments. Begin treatment along the shore and proceed outward in bands to allow aquatic organisms to move into untreated areas.

Avoid wash-off of sprayed foliage by spray boat or recreational boat backwash for one hour after application.

Apply **HABITAT** at 2 to 6 pints per acre depending on species present and weed density. DO NOT exceed the maximum label rate of 6 pints per acre (1.5 lb ai/A) per year. Use the higher labeled rates for heavy weed pressure. Consult the **AQUATIC WEEDS CONTROLLED** section and the **ADDITIONAL WEEDS CONTROLLED BY HABITAT HERBICIDE** section of this label for specific rates.

HABITAT may be applied as a draw down treatment in areas described above. Apply **HABITAT** to weeds after water has been drained and allow 14 days before reintroduction of water.

PRECAUTIONS FOR AVOIDING INJURY TO NON-TARGET PLANTS

Untreated desirable plants can be affected by root uptake of **HABITAT** from treated soil. Injury or loss of desirable plants may result if **HABITAT** is applied on or near desirable plants, on areas where their roots extend, or in locations where the treated soil may be washed or moved into contact with their roots. When making applications along shorelines where desirable plants may be present, caution should be exercised to avoid spray contact with their foliage or spray application to the soil in which they are rooted. Shoreline plants that have roots that extend into the water in an area where **HABITAT** has been applied generally will not be adversely affected by uptake of the herbicide from the water.

If treated vegetation is to be removed from the application site, DO NOT use the vegetative matter as mulch or compost on or around desirable species.

MANAGING OFF-TARGET MOVEMENT

Spray Drift: 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 entity authorizing spraying are responsible for considering all these factors when making decisions.

Spray drift from applying this product may result in damage to sensitive plants adjacent to the treatment area. Only apply this product when the potential for drift to these and other adjacent sensitive areas (e.g. residential areas, bodies of water, known habitat for threatened or endangered species, or non-target crops) is minimal. Do not apply when the following conditions exist that increase the likelihood of spray drift from intended targets: high or gusty winds, high temperatures, low humidity, temperature inversions.

To minimize spray drift, the applicator should be familiar with and take into account the following drift reduction advisory information. Additional information may be available from state enforcement agencies or the Cooperative Extension on the application of this product.

The best drift management strategy and most effective way to reduce drift potential are to apply large 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 recommended practice. 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 the largest droplets and the lowest drift. Do not use nozzles producing a mist droplet spray.

APPLICATION HEIGHT

Making applications at the lowest possible height (helicopter, ground driven spray boom) that is safe and practical 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 treatment area, the applicator must compensate for this displacement by adjusting the path of the application

equipment (e.g. aircraft, ground) upwind. Swath adjustment distance should increase with increasing drift potential (higher wind, smaller droplets, etc.).

WIND

Drift potential is lowest between wind speeds of 3-10 mph. However, many factors, including droplet size and equipment type, determine drift potential at any given speed. Application should be avoided below 3 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

Drift potential is high during a temperature inversion. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain in a concentrated cloud, which 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.

WIND EROSION

Avoid treating powdery dry or light sandy soils when conditions are favorable for wind erosion. Under these conditions, the soil surface should first be settled by rainfall or irrigation.

AERIAL APPLICATION METHODS AND EQUIPMENT HELICOPTERS ONLY

Water Volume: Use 2 or more gallons of water per acre. The actual minimum spray volume per acre is determined by the spray equipment used. Use adequate spray volume to provide accurate and uniform distribution of spray particles over the treated area and to avoid spray drift.

Managing spray drift from aerial applications: Applicators must follow these requirements to avoid off-target drift movement: 1) boom length - the distance of the outermost nozzles on the boom must not exceed ¾ the length of the rotor, 2) nozzle orientation - nozzles must always point backward parallel with the air stream and never be pointed downwards more than 45 degrees, and 3) application height - without compromising helicopter safety, applications should made at a height of 10 feet or less above the crop canopy or tallest plants. Applicators must follow the most restrictive use cautions to avoid drift hazards, including those found in this labeling as well as applicable state and local regulations and ordinances.

GROUND APPLICATION (BROADCAST)

Water Volume: Use 5 or more gallons of water per acre. The actual minimum spray volume per acre is determined by the spray equipment used. Use adequate spray volume to provide accurate and uniform distribution of spray particles over the treated area and to avoid spray drift.

ADJUVANTS

Postemergence applications of **HABITAT® herbicide** require the addition of a spray adjuvant. Only spray adjuvants that are approved or appropriate for aquatic use should be utilized.

Nonionic Surfactants: Use a nonionic surfactant at the rate 0.25% v/v or higher (see manufacturer's label) of the spray solution (0.25% v/v is equivalent to 1 quart in 100 gallons). For best results, select a nonionic surfactant with a HLB (hydrophilic to lipophilic balance) ratio between 12 and 17 with at least 70% surfactant in the formulated product (alcohols, fatty acids, oils, ethylene glycol or diethylene glycol should not be considered as surfactants to meet the above requirements).

Methylated Seed Oils or Vegetable Oil Concentrates: Instead of a surfactant, a methylated seed oil or vegetable-based seed oil concentrate may be used at the rate of 1.5 to 2 pints per acre. When using spray volumes greater than 30 gallons per acre, methylated seed oil or vegetable based seed oil concentrates should be mixed at a rate of 1% of the total spray volume, or alternatively use a nonionic surfactant as described above. Research indicates that these oils may aid in **HABITAT** deposition and uptake by plants under moisture or temperature stress.

Silicone Based Surfactants: See manufacturer's label for specific rate recommendations. Silicone-based surfactants may reduce the surface tension of the spray droplet, allowing greater spreading on the leaf surface as compared to conventional nonionic surfactants. However, some silicone-based surfactants may dry too quickly, limiting herbicide uptake.

Invert emulsions: HABITAT can be applied as an invert emulsion. The spray solution results in an invert (water-in-oil) spray emulsion designed to minimize spray drift and spray run-off, resulting in more herbicide on the target foliage. The spray emulsion may be formed in a single tank (batch mixing) or injected (in-line mixing). Consult the invert chemical label for proper mixing directions.

Other: An antifoaming agent, spray pattern indicator or drift reducing agent may be applied at the product labeled rate if necessary or desired.

TANK MIXES

HABITAT may be tank-mixed with other aquatic use herbicides for the control of emergent and floating aquatic vegetation.

Consult manufacturer's labels for specific rates and weeds controlled. Always follow the more restrictive label when making an application involving tank-mixes.

AERIAL APPLICATIONS

All precautions should be taken to minimize or eliminate spray drift. Helicopters can be used to apply **HABITAT**; however, DO NOT make applications by helicopter unless appropriate buffer zones can be maintained to prevent spray drift out of the target area, or when spray drift as a result of helicopter application can be tolerated. Aerial equipment designed to minimize spray drift, such as a helicopter equipped with a Microfoil™ boom, Thru-Valve™ boom or raindrop nozzles, must be used and calibrated. Except when applying with a Microfoil boom, a drift control agent may be added at the recommended label rate. To avoid drift, applications should not be made during inversion conditions, when winds are gusty, or any other conditions which allow drift. Side trimming is not recommended with **HABITAT** unless death of treated tree can be tolerated.

Uniformly apply the recommended amount of **HABITAT** in 5 to 30 gallons of water per acre; include in the spray solution a nonionic surfactant or methylated seed oil or manufacturer's label rate of a silicone-based surfactant (See the **Adjuvants** section of this label for specific recommendations). A foam reducing agent may be added at the recommended label rate, if needed.

IMPORTANT: Thoroughly clean application equipment, including landing gear, immediately after use of this product. Prolonged exposure of this product to uncoated steel (except stainless steel) surfaces may result in corrosion and failure of

the exposed part. The maintenance of an organic coating (paint) may prevent corrosion.

GROUND APPLICATIONS

FOLIAR APPLICATIONS

Low Volume Foliar:

Use equipment calibrated to deliver 5 to 20 gallons of spray solution per acre. To prepare the spray solution, thoroughly mix in water 0.5 to 5% **HABITAT® herbicide** plus surfactant (see the **ADJUVANTS** section of this label for specific recommendations). A foam reducing agent may be applied at the recommended label rate, if needed. For control of difficult species (see **AQUATIC WEEDS CONTROLLED** section and the **ADDITIONAL WEEDS CONTROLLED BY HABITAT** section for relative susceptibility of weed species), use the higher concentrations of herbicide and/or spray volumes but do not apply more than 6 pints of **HABITAT** per acre. Excessive wetting of foliage is not recommended. See the **MIXING GUIDE** below for some suggested volumes of **HABITAT** and water.

For low volume, select proper nozzles to avoid over-application. Proper application is critical to ensure desirable results. Best results are achieved when the spray covers the crown and approximately 70 percent of the plant. The use of an even flat fan tip with a spray angle of 40 degrees or less will aid in proper deposition.

Recommended tip sizes include 4004E, or 1504E. For a straight stream and cone pattern, adjustable cone nozzles such as 5500 X3 or 5500 X4 may be used. Attaching a rollover valve onto a Spraying Systems Model 30 gunjet or other similar spray guns allows for the use of both a flat fan and cone tips on the same gun.

Moisten, but do not drench target vegetation causing spray solution to run off.

Low Volume Foliar with Backpacks:

For low-growing species, spray down on the crown, covering crown and penetrating approximately 70% of the plant.

For target species 4 to 8 feet tall, swipe the sides of target vegetation by directing spray to at least two sides of the plant in smooth vertical motions from the crown to the bottom. Make sure to cover the crown whenever possible.

For target species over 8 feet tall, lace sides of the target vegetation by directing spray to at least two sides of the target in smooth zigzag motions from crown to bottom.

Low Volume Foliar with Hydraulic Handgun Application Equipment:

Use same technique as described above for **Low Volume with Backpacks**.

For broadcast applications, simulate a gentle rain near the top of target vegetation, allowing spray to contact the crown and penetrate the target foliage without falling to the understory. Herbicide spray solution which contacts the understory may result in severe injury or death of plants in the understory.

SPRAY SOLUTION MIXING GUIDE FOR LOW-VOLUME FOLIAR APPLICATIONS

AMOUNT OF SPRAY SOLUTION BEING PREPARED	DESIRED CONCENTRATION (fluid volume)				
	0.5%	0.75%	1%	1.5%	5%
	(amount of **HABITAT** to use)				
1 gallon	0.6 oz.	0.9 oz.	1.3 oz.	1.9 oz.	6.5 oz.
3 gallons	1.9 oz.	2.8 oz.	3.8 oz.	5.8 oz.	1.2 pint
4 gallons	2.5 oz.	3.8 oz.	5.1 oz.	7.7 oz.	1.6 pint
5 gallons	3.2 oz.	4.8 oz.	6.5 oz.	9.6 oz.	2 pints
50 gallons	2 pints	3 pints	4 pints	6 pints	10 quarts
100 gallons	4 pints	6 pints	8 pints	6 quarts	5 gallons

2 tablespoons = 1 fluid ounce

High Volume Foliar:

For optimum performance when spraying medium to high-density vegetation, use equipment calibrated to deliver up to 100 gallons of spray solution per acre (GPA). Spray solutions exceeding 100 GPA may result in excessive spray run-off, causing increased ground cover injury, and injury to desirable species. To prepare the spray solution, thoroughly mix **HABITAT** in water and add a surfactant (see **ADJUVANT** section for specific recommendations and rates of surfactants). A foam-reducing agent may be added at the recommended label rate, if needed. For control of difficult species (see **AQUATIC WEEDS CONTROLLED** section and the **ADDITIONAL WEEDS CONTROLLED BY HABITAT** section for relative susceptibility of weed species), use the higher concentrations of herbicide and/or spray volumes, but do not apply more than 6 pints of **HABITAT** per acre. Uniformly cover the foliage of the vegetation to be controlled but do not apply to run-off. Excessive wetting of foliage is not recommended.

Side Trimming:

DO NOT side trim with **HABITAT** unless severe injury or death of the treated tree can be tolerated. **HABITAT** is readily translocated and can result in death of the entire tree.

CUT SURFACE TREATMENTS

HABITAT may be used to control undesirable woody vegetation by applying the **HABITAT** solution to the cambium area of freshly cut stump surfaces or to fresh cuts on the stem of the target woody vegetation. Applications can be made at any time of the year except during periods of heavy sap flow in the spring. Do not overapply solution causing run-off from the cut surface.

Injury may occur to desirable woody plants if the shoots extend from the same root system or their root systems are grafted to those of the treated tree.

CUT SURFACE APPLICATIONS WITH DILUTE AND CONCENTRATE SOLUTIONS:

HABITAT may be mixed as either a concentrated or dilute solution. The dilute solution may be used for applications to the cut surface of the stump or to cuts on the stem of the target woody vegetation. Concentrated solutions may be used for applications to cuts on the stem. Use of the concentrated solution permits application to fewer cuts on the stem, especially for large diameter trees. Follow the application instructions to determine proper application techniques for each type of solution.

- To prepare a dilute solution, mix 8 to 12 fluid ounces of **HABITAT® herbicide** with one gallon of water. The use of a surfactant or penetrating agent may improve uptake through partially callused cambiums.
- To prepare a concentrated solution, mix 2 quarts of **HABITAT** with no more than 1 quart of water.

Cut stump treatments:

- Dilute Solution- spray or brush the solution onto the cambium area of the freshly cut stump surface. Insure that the solution thoroughly wets the entire cambium area (the wood next to the bark of the stump).

Cut stem (injection, hack & squirt) treatments:

- Dilute Solutions- Using standard injection equipment, apply 1 milliliter of solution at each injection site around the tree with no more than one-inch intervals between cut edges. Insure that the injector completely penetrates the bark at each injection site.
- Concentrate Solutions- Using standard injection equipment, apply 1 milliliter of solution at each injection site. Make at least one injection cut for every 3 inches of Diameter at Breast Height (DBH) on the target tree. For example, a 3-inch DBH tree will receive 1 injection cut and a 6-inch DBH tree will receive 2 injection cuts. On trees requiring more than one injection site place the injection cuts at approximately equal intervals around the tree.

Frill or girdle treatments:

- Using a hatchet, machete, or chainsaw, make cuts through the bark and completely around the tree to expose the cambium. The cut should angle downward extending into the cambium enough to expose at least two growth rings. Using a spray applicator or brush, apply a 25% to 100% solution of **HABITAT** into each cut until thoroughly wet. Avoid applying so much herbicide that runoff to the ground or water occurs.

AQUATIC SPECIES CONTROLLED

HABITAT® herbicide will control the following target species as specified in the BASF RECOMMENDATION section of the table. Rate recommendations are expressed in terms of product volume for broadcast applications and as a % solution for directed applications including spot treatments. **For % solution applications, DO NOT apply more than the equivalent of 3 quarts of HABITAT per acre.**

COMMON NAME	SCIENTIFIC NAME	BASF RECOMMENDATION
Floating Species		
*Duckweed	*Lemna minor*	2-3 pints/acre (1% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Duckweed, Giant	*Spirodela polyriza*	2-3 pints/acre (1% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Frogbit	*Limnobium spongia*	1-2 pints/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Spatterdock	*Nuphar luteum*	Apply a tank-mix of 2-4 pints/acre **HABITAT** + 4 to 6 pints/acre glyphosate (0.5% **HABITAT** + 1.5% glyphosate) in 100 GPA water for best control. Ensure 100% coverage of actively growing, emergent foliage.
*Water Hyacinth	*Eichhornia crassipes*	1-2 pints/acre (0.5% solution) applied in 100 GPA water to actively growing foliage.
*Water Lettuce	*Pistia stratiotes*	1-2 pints/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
Emerged Species		
*Alligatorweed	*Alternanthera philoxeroides*	1 to 4 pints/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage. Tank-mix with glyphosate is NOT recommended, and may reduce alligatorweed control, requiring higher **HABITAT** rates.
*Arrowhead, Duck-potato	*Sagittaria spp.*	1-2 pints/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Bacopa, lemon	*Bacopa spp.*	1-2 pints/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Parrot feather	*Myriophyllum aquaticum*	Must be foliage above water for sufficient **HABITAT** uptake. Apply 2 - 4 pints to actively growing emergent foliage.
*Pennywort	*Hydrocotyle spp.*	1-2 pints/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Pickerelweed	*Pontederia cordata*	2-3 pints/acre (1% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Taro, wild; Dasheen; Elephant's Ear; Coco Yam	*Colocasia esculentum*	4-6 pints/acre (1.5% solution) applied in 100 GPA with a high quality 'sticker' adjuvant. Ensure good coverage of actively growing, emergent foliage.
*Water lily	*Nymphaea odorata*	2-3 pints/acre (1% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Water primrose	*Ludwigia uruguayensis*	4-6 pints/acre (1.5% solution), ensure 100% coverage of actively growing, emergent foliage. Tank-mix with glyphosate is NOT recommended and may reduce water primrose control.

* Not approved for use in California

(continued)

AQUATIC SPECIES CONTROLLED *(continued)*

COMMON NAME	SCIENTIFIC NAME	BASF RECOMMENDATION
Terrestrial/Marginal		
*Soda Apple, aquatic; Nightshade	*Solanum tampicense*	2 pts./acre applied to foliage
*Bamboo, Japanese	*Phyllostachys spp.*	3 to 4 pints/acre applied to the foliage when plant is actively growing. Before setting seed head. More foliage will result in greater herbicide uptake, resulting in greater root kill.
Brazilian Pepper; Christmasberry	*Schinus terebinthifolius*	2 - 4 pints/acre applied to foliage
Cattail	*Typha spp.*	2-4 pints (1% solution) applied to actively growing, green foliage after full leaf elongation. Lower rates will control cattail in the north; higher rates are needed in the south.
Chinese Tallow Tree	*Sapium sebiferum*	16 to 24 oz applied to foliage
Cogon Grass	*Imperata cylindrica*	Burn foliage, till area, that fall spray 2 qt./acre **HABITAT® herbicide** + MSO applied to new growth.
Cordgrass, prairie	*Spartina spp.*	4-6 pints applied to actively growing foliage
*Cutgrass	*Zizaniopsis miliacea*	4-6 pints applied to actively growing foliage
*Elephant Grass; Napier Grass-	*Pennisetum purpureum*	3 pts./acre applied to actively growing foliage
*Flowering rush	*Butumu typla*	2-3 pints applied to actively growing foliage
Giant Reed, Wild Cane	*Arundo donax*	4 to 6 pints/acre applied in spring to actively growing foliage
*Golden Bamboo	*Phyllostachys aurea*	3 to 4 pints/acre applied to the foliage when plant is actively growing. Before setting seed head. More foliage will result in greater herbicide uptake, resulting in greater root kill.
Junglerice	*Echinochloa colonum*	3-4 pints applied to actively growing foliage
Knapweeds	*Centaurea species*	Russian Knapweed - 2 to 3 pints + 1 qt./acre MSO fall applied after senescence begins
Knotweed, Japanese (see Fallopia japonica)	*Polygonum cuspidatum*	3 to 4 pts./acre applied postemergence to actively growing foliage
Melaleuca; Paperbark Tree	*Melaleuca quinquenervia*	For established stands, apply 6 pints/acre **HABITAT** + 6 pints/acre glyphosate + spray adjuvant. For best results use 4 qt./A methylated seed oil as an adjuvant. For ground foliar application, uniformly apply to ensure 100% coverage. For broadcast foliar control, apply aerially in a minimum of two passes at 10 gallons/acre applied cross treatment. For spot treatment use a 25% **HABITAT** + 25% solution of + glyphosate + 1.25% MSO in water applied as a frill or stump treatment.
*Nutgrass; Kili'p'opu	*Cyperus rotundus*	2 pints **HABITAT** + 1 qt./acre MSO applied early postemergence
*Nutsedge	*Cyperus spp.*	2 to 3 pints postemergence to foliage or pre-emergence incorporated, non-incorporated preemergence applications will not control.

* Not approved for use in California

(continued)

AQUATIC SPECIES CONTROLLED *(continued)*

COMMON NAME	SCIENTIFIC NAME	BASF RECOMMENDATION
Terrestrial/Marginal (Cont.)		
Phragmites; Common Reed	*Phragmites australis*	4 to 6 pints/acre applied to actively growing, green foliage after full leaf elongation, ensure 100% coverage. If stand has a substantial amount of old stem tissue, mow or burn, allow to regrow to approximately 5' tall before treatment. Lower rates will control phragmites in the north; higher rates are needed in the south.
*Poison Hemlock	*Conium maculatum*	2 pints **HABITAT® herbicide** + 1 qt./acre MSO applied preemergence to early postemergence to rosette, prior to flowering
Purple Loosestrife	*Lythrum salicaria*	1 pint/acre applied to actively growing foliage
Reed canarygrass	*Phalaris arundinacea*	3 to 4 pints/acre applied to actively growing foliage
Rose, swamp	*Rosa palustris*	2 to 3 pts./acre applied to actively growing foliage
Russian-Olive	*Elaeagnus angustifolia*	2 to 4 pints/acre or a 1% solution, applied to foliage
Saltcedar; Tamarisk	*Tamarix species*	Aerial apply 2 qts. **HABITAT** + 0.25%v/v NIS applied to actively growing foliage during flowering. For spot spraying use 1% solution of **HABITAT** + 0.25%v/v NIS and spray to wet foliage. After application wait at least two years before disturbing treated saltcedar. Earlier disturbance can reduce overall control.
Smartweed	*Polygonum* spp.	2 pints/acre applied early postemergence
Sumac	*Rhus spp.*	2 to 3 pts./acre applied to foliage
Swamp Morning Glory; Water Spinach; Kangkong	*Ipomoea aquatica*	1 to 2 pints/acre **HABITAT** + 1 qt./acre MSO applied early postemergence
Torpedo Grass	*Panicum repens*	4 pints/acre (1 - 1.5% solution), ensure good coverage to actively growing foliage.
*White Top; Hoary Cress	*Cardaria draba*	1 to 2 pints/acre applied in spring, to foliage, during flowering.
Willow	*Salix* spp.	2 to 3 pts./acre **HABITAT** applied to actively growing foliage, ensure good coverage.

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ADDITIONAL WEEDS CONTROLLED BY HABITAT HERBICIDE

In terrestrial sites, **HABITAT** will provide preemergence or postemergence control with residual control of the following target vegetation species at the rates listed. Residual control refers to control of newly germinating seedlings in both annuals and perennials. In general, annual weeds may be controlled by preemergence or postemergence applications of **HABITAT**. **For established biennials and perennials postemergence applications of HABITAT are recommended.**

The rates shown below pertain to broadcast applications and indicate the relative sensitivity of these weeds. The relative sensitivity should be referenced when preparing low volume spray solutions (see "Low Volume" section of "Ground Applications"); low volume applications may provide control of the target species with less **HABITAT** per acre than is shown for the broadcast treatments. **HABITAT** should be used only in accordance with the recommendations on this label and the leaflet label.

The relative sensitivity of the species listed below can also be used to determine the relative risk of causing non-target plant injury if any of the below listed species are considered to be desirable within the area to be treated.

Resistant Biotypes: Naturally occurring biotypes (a plant within a given species that has a slightly different, but distinct genetic makeup from other plants of the same species) of some weeds listed on this label may not be effectively controlled. If naturally occurring resistant biotypes are present in an area, **HABITAT** should be tank-mixed or applied sequentially with an appropriate registered herbicide having a different mode of action to ensure control.

GRASSES

COMMON NAME	SPECIES	GROWTH HABIT[2]
Apply 2-3 pints per acre[1]		
Annual bluegrass	*(Poa annua)*	A
Broadleaf signalgrass	*(Brachiaria platyphylla)*	A
Canada bluegrass	*(Poa compressa)*	P
Downy brome	*(Bromus tectorum)*	A
Fescue	*(Festuca* spp.*)*	A/P
Foxtail	*(Setaria* spp.*)*	A
Italian ryegrass	*(Lolium multiflorum)*	A
Johnsongrass	*(Sorghum halepense)*	P
Kentucky bluegrass	*(Poa pratensis)*	P
Lovegrass	*(Eragrostis* spp.*)*	A/P
*Napier grass	*(Pennisetum purpureum)*	P
Orchardgrass	*(Dactylis glomerata)*	P
Paragrass	*(Brachiaria mutica)*	P
Quackgrass	*(Agropyron repens)*	P
Sandbur	*(Cenchrus* spp.*)*	A
Sand dropseed	*(Sporobulus cryptandrus)*	P
Smooth brome	*(Bromus inermis)*	P
Vaseygrass	*(Paspalum urvillei)*	P
Wild oats	*(Avena fatua)*	A
Witchgrass	*(Panicum capillare)*	A
Apply 3-4 pints per acre[1]		
Barnyardgrass	*(Echinochloa crus-gali)*	A
Beardgrass	*(Andropogon* spp.*)*	P
Bluegrass, Annual	*(Poa annua)*	A
*Bulrush	*(Scirpus validus)*	P
Cheat	*(Bromus secalinus)*	A
Crabgrass	*(Digitaria* spp.*)*	A
Crowfootgrass	*(Dactyloctenium aegyptium)*	A
Fall panicum	*(Panicum dichotomiflorum)*	A
Goosegrass	*(Eleusine indica)*	A
Itchgrass	*(Rottboellia exaltata)*	A
Lovegrass	*(Eragrostis* spp.*)*	A
*Maidencane	*(Panicum hemitomon)*	A
Panicum, Browntop	*(Panicum fasciculatum)*	A
Panicum, Texas	*(Panicum texanum)*	A
Prairie threeawn	*(Aristida oligantha)*	P
Sandbur, Field	*(Cenchrus incertus)*	A
Signalgrass	*(Brachiaria platyphylla)*	A
Wild barley	*(Hordeum* spp.*)*	A
Wooly Cupgrass	*(Eriochloa villosa)*	A
Apply 4-6 pints per acre[1]		
Bahiagrass	*(Paspalum notatum)*	P
Bermudagrass[3]	*(Cynodon dactylon)*	P
Big bluestem	*(Andropogon gerardii)*	P
Dallisgrass	*(Paspalum dilatatum)*	P
Feathertop	*(Pennisetum villosum)*	P
Guineagrass	*(Panicum maximum)*	P
Saltgrass[3]	*(Distichlis stricta)*	P
Sand dropseed	*(Sporobolus cryptandrus)*	P

GRASSES (CONT)

COMMON NAME	SPECIES	GROWTH HABIT[2]
Sprangletop	*(Leptochloa* spp.*)*	A
Timothy	*(Phleum pratense)*	P
Wirestem muhly	*(Muhlenbergia frondosa)*	P

BROADLEAF WEEDS

COMMON NAME	SPECIES	GROWTH HABIT[2]
Apply 2-3 pints per acre[1]		
Burdock	*(Arctium* spp.*)*	B
Carpetweed	*(Mollugo verticillata)*	A
Carolina geranium	*(Geranium carolinianum)*	*A*
Clover	*(Trifolium* spp.*)*	A/P
Common chickweed	*(Stellaria media)*	A
Common ragweed	*(Ambrosia artemisiifolia)*	A
Dandelion	*(Taraxacum officinale)*	P
Dog fennel	*(Eupatorium capillifolium)*	A
Filaree	(*Erodium* spp.*)*	A
Fleabane	*(Erigeron* spp.*)*	A
Hoary vervain	*(Verbena stricta)*	P
Indian mustard	(*Brassica juncea)*	A
Kochia	*(Kochia scoparia)*	A
Lambsquarters	*(Chenopodium album)*	A
*Lespedeza	(*Lespedeza* spp.*)*	P
Miners lettuce	*(Montia perfoliata)*	A
Mullein	*(Verbascum* spp.*)*	B
Nettleleaf goosefoot	*(Chenopodium murale)*	A
Oxeye daisy	*(Chrysanthemum leucanthemum)*	P
Pepperweed	*(Lepidium* spp.)	A
Pigweed	*(Amaranthus* spp.*)*	A
Puncturevine	*(Tribulus terrestris)*	A
Russian thistle	*(Salsola kali)*	A
Smartweed	*(Polygonum* spp.*)*	A/P
Sorrell	*(Rumex* spp.*)*	P
Sunflower	*(Helianthus* spp.*)*	A
Sweet clover	*(Melilotus* spp.*)*	A/B
Tansymustard	(*Descurainia pinnata)*	A
Western ragweed	*(Ambrosia psilostachya)*	P
Wild carrot	(*Daucus carota)*	B
Wild lettuce	*(Lactuca* spp.*)*	A/B
Wild parsnip	*(Pastinaca sativa)*	B
Wild turnip	*(Brassica campestris)*	B
Woollyleaf bursage	*(Franseria tomentosa)*	P
Yellow woodsorrel	*(Oxalis stricta)*	P
Apply 3-4 pints per acre[1]		
Broom snakeweed[4]	*(Gutierrezia sarothrae)*	P
Bull thistle	*(Cirsium vulgare)*	B
Burclover	*(Medicago* spp.)	A
Chickweed, Mouseear	*(Cerastium vulgatum)*	A
Clover, Hop	*(Trifolium procumbens)*	A
Cocklebur	*(Xanthium strumarium)*	A

BROADLEAF WEEDS (CONT)

COMMON NAME	SPECIES	GROWTH HABIT[2]
Cudweed	*(Gnaphalium* spp.*)*	A
Desert Camelthorn	*(Alhagi pseudalhagi)*	P
Dock	*(Rumex* spp.*)*	P
Fiddleneck	*(Amsinckia intermedia)*	A
Goldenrod	*(Solidago* spp.*)*	P
Henbit	*(Lamium aplexicaule)*	A
Knotweed, prostrate	*(Polygonum aviculare)*	A/P
Pokeweed	*(Phytolacca americana)*	P
Purslane	*(Portulaca* spp.*)*	A
Pusley, Florida	*(Richardia scabra)*	A
Rocket, London	*(Sisymbrium irio)*	A
Rush skeletonweed[4]	*(Chondrilla juncea)*	B
Saltbush	*(Atriplex* spp.)	A
Shepherd's-purse	*(Capsella bursa-pastoris)*	A
Spurge, Annual	*(Euphorbia* spp.*)*	A
Stinging nettle[4]	*(Urtica dioica)*	P
Velvetleaf	*(Abutilon theophrasti)*	A
Yellow starthistle	*(Centaurea solstitialis)*	A
Apply 4-6 pints per acre[1]		
Arrowwood	*(Pluchea sericea)*	A
Canada thistle	*(Cirsium arvense)*	P
Giant ragweed	*(Ambrosia trifida)*	A
Grey rabbitbrush	*(Chrysothamnus nauseosus)*	P
Little mallow	*(Malva parviflora)*	B
Milkweed	*(Asclepias* spp.*)*	P
Primrose	*(Oenothera kunthiana)*	P
Silverleaf nightshade	*(Solanum eleagnifolium)*	P
Sowthistle	*(Sonchus* spp.*)*	A
Texas thistle	*(Cirsium texanum)*	P

VINES AND BRAMBLES

COMMON NAME	SPECIES	GROWTH HABIT[2]
Apply 1 pint per acre		
Field bindweed	*(Convolvulus arvensis)*	P
Hedge bindweed	*(Calystegia sequium)*	A
Apply 2-3 pints per acre[1]		
Wild buckwheat	*(Polygonum convolvulus)*	P
Apply 3-4 pints per acre[1]		
Greenbriar	*(Smilax* spp.*)*	P
Honeysuckle	*(Lonicera* spp.*)*	P
Morningglory	*(Ipomoea* spp.*)*	A/P
Poison ivy	*(Rhus radicans)*	P
Redvine	*(Brunnichia cirrhosa)*	P
Wild rose	*(Rosa* spp.*)*	P
Including:		
Multiflora rose	*(Rosa multiflora)*	P
McCartney rose	*(Rosa bracteata)*	P
Apply 4-6 pints per acre[1]		
*Kudzu[3]	*(Pueraria lobata)*	P
Trumpetcreeper	*(Campsis radicans)*	P
Virginia creeper	*(Parthenocissus quinquefolia)*	P
Wild grape	*(Vitis* spp.*)*	P

BRUSH SPECIES

COMMON NAME	SPECIES	GROWTH HABIT[2]
Apply 4-6 pints per acre[1]		
American beech	*(Fagus grandifolia)*	P
Ash	(*Fraxinius* spp.)	P
Bald cypress	*(Taxodium distichum)*	P
Bigleaf maple	*(Acer macrophylum)*	P
Black locust[5]	*(Robinia pseudoacacia)*	P
Black gum	*(Nyssa sylvatica)*	P
Box elder	*(Acer negundo)*	P
Cherry	*(Prunus* spp.*)*	P
Chinaberry	*(Melia azadarach)*	P
Dogwood	*(Cornus* spp.*)*	P
Elm[6]	*(Ulmus* spp.*)*	P
Hawthorn	*(Crataegus* spp.*)*	P
Hickory	*(Carya* spp.*)*	P
Honeylocust[5]	*(Gleditsia triacanthos)*	P
Maple	*(Acer* spp.*)*	P
Mulberry	*(Morus* spp.*)*	P
Oak	(Quercus spp.)	P
Persimmon	*(Diospyros virginiana)*	P
*Pine[5]	*(Pinus* spp.*)*	P
Poplar	*(Populus* spp.*)*	P
Privet	*(Ligustrum vulgare)*	P
Red Alder	*(Alnus rubra)*	P
Red Maple	*(Acer rubrum)*	P
Russian Olive	*(Eleagnus angustifolia)*	P
Sassafras	*(Sassafras albidum)*	P
Sourwood	*(Oxydendrum arboreum*)	P
Sweetgum	*(Liquidambar styraciflua)*	P
*Water willow	*(Justica americana)*	P
Willow	*(Salix* spp.*)*	P
Yellow poplar	*(Liriodendron tulipifera*)	P

[1] The higher rates should be used where heavy or well-established infestations occur.

[2] Growth Habit - A = Annual, B = Biennial, P = Perennial

[3] Use a minimum of 75 GPA - Control of established stands may require repeat applications.

[4] For best results early postemergence applications are required.

[5] Tank mix with glyphosate or triclopyr.

[6] Tank-mix with with glyphosate.

* Not approved for use in California

DISCLAIMER

The label instructions for the use of this product reflect the opinion of experts based on research and field use. The directions are believed to be reliable and should be followed carefully. However, it is impossible to eliminate all risks inherently associated with use of this product. Turf injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the use of, or application of the product contrary to label instructions, all of which are beyond the control of BASF Corporation (BASF). All such risks shall be assumed by the user.

BASF shall not be responsible for losses or damages resulting from use of this product in any manner not set forth on this label. User assumes all risks associated with the use of this product in any manner not specifically set forth on this label.

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BASF Corporation

26 Davis Drive

Research Triangle Park, NC 27709

BASF

The Chemical Company

Appendix D.

Potential Vendors for Herbicide Control of Phragmites in Virginia

Potential Vendors for
Aerial Application of Herbicides to Control Phragmites in Virginia
2009

VENDOR
Helicopter Applicators, Inc. 1670 York Rd Gettysburg, PA 17325 717-337-1370
UAP Timberland, LLC Attn: Charles Smyth 1850 Touchstone Road Colonial Heights, VA 23834 804-520-0789 Charles.Smyth@uap.com
Evergreen Helicopters, Inc. 1629 K Street NW, Suite 301 Washington, DC 20006-1602 202-466-2929
NatureChem, Inc. P.O. Box 63335 Charlotte, NC 28263 803-957-8989
Summit Helicopters Attn: Paul Thomas 8617 Harrell Mill Rd Waverly, VA 23890 804-834-2336
Aegis Environmental, Inc. Attn: Kelly Bonds 211 Ruthers Road, Suite 202 Richmond, VA 23235 804-675-1220
Atlantic Industrial Services, Inc Attn: Ron Thompson 13331 Ramblewood Dr. Chester, VA 23836 804-748-9208
BEM Systems, Inc. Attn: Paul Goldsmith 606 Thimble Shoals Blvd. Suite A2 Newport News, VA 23606 757-591-9466
Bay Environmental, Inc. Attn: Bruce Comstock PO Box 2666 Chesapeake, VA 23327 757-420-9506

Buck Engineering, PC Attn: James Buck 8000 Regency Pkwy, Suite 200 Cary, NC 27511 919-463-5488
Daniel Penn Associates, LLC Attn: Antonio Rodriquez 151 New Park Ave Hartford, CT 06106 860-232-8577
DoRoCo, LLC Attn: Donna Colburn 4810 S County Trail Charlestown, RI 02813 401-364-7604
Environmental & Energy Publishing, LLC Attn: Drew Gagliano 122 C St. NW, Suite 722 Washington, DC 20001 202-737-4340
LCM Corp. Attn: Ed Thompson PO Box 13487 Roanoke, VA 24034 540-344-5583
Crabbe Aviation, Inc. 8271 Elizabeth Ann Dr. Mechanicsville, VA 23111 804-334-7370

Potential Vendors for
Ground Application of Herbicides to Control Phragmites in Virginia
2009

Aquatic Nuisance Plant Control
Chesapeake, VA
757-420-3323
(ground)

Aquatic Resources Management
Virginia Beach, VA
800-715-1715
www.armva.com
Contact: Steve Weekly
(ground and boat-based spray equipment)

Resource Management Associates
Locustville, VA
757-787-2637, ext. 10
757-787-2411 (fax)
www.naturalresourcesconsulting.com
Contact: Steve Mallette
conserve@visi.net

Virginia Lake Management
Virginia Beach, Virginia
757-591-8780
866-697-2584 (toll free)
757-873-4896 (fax)
www.virginialakemanagement.com
Contact: Kevin Tucker
(ground, amphibious vehicle, boat-based spray equipment)

Weedpro
31510 Zion Rd.
Parsonburg, MD 21849
410-742-2973
410-430-6180
Contact: Jim Samis
jjsamis@aol.com
(ground)