Black Lake

Integrated Aquatic Vegetation Management Plan









THURSTON COUNTY
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BLACK LAKE INTEGRATED AQUATIC VEGETATION MANAGEMENT PLAN

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EXECUTIVE SUMMARY

The presence of the nuisance aquatic plants is common to many lakes throughout Washington and the Pacific Northwest. Dense growth limits recreation, navigation, disrupts natural water flow, and impacts water quality. In particular, boating, swimming, fishing, and aesthetic enjoyment have been severely impacted by growth of non-native, and even nuisance native aquatic plants in Black Lake. In particular, non-native fragrant waterlily (*Nymphaea odorata*) and yellow iris (*Iris pseudacorus*) are encroaching upon the shoreline and open water area of the lake. Not only are all parts of yellow iris poisonous, causing skin irritation, but the plant forms dense colonies that alter shoreline and aquatic habitat. The fragrant waterlily can grow to nuisance densities and, in response to high nutrient availability, accelerate nutrient over-enrichment of a water body. The submersed water nymph (*Najas flexilis*) dominates much of the open water despite being a native species. A common non-native, Eurasian watermilfoil (*Myriophyllum spicatum*), has been aggressively managed since 2006 and is now found in satellite populations around the lake that are regularly removed.

To date, hand-pulling has been used to control milfoil growth and harvesters have been used to control fragrant waterlily. These control methods; however, have not resulted in the level of success desired by lake residents and is not sufficient to reduce nuisance plant growth throughout the summer recreational season nor to maintain the beneficial uses of the lake.

The purpose of the Black Lake Integrated Aquatic Vegetation Management Plan (IAVMP) is to develop a long-term strategy to be implemented by Thurston County and citizens of the Save Black Lake Coalition to eradicate milfoil, fragrant waterlily, and yellow iris from Black Lake and to have a quick response protocol in place if milfoil is re-introduced into the lake. At the same time the IAVMP will serve as a guide to continue improving existing beneficial and recreational uses, and insure water quality meets future demands. To achieve these goals, a multi-year and dedicated management strategy must include:

- Community buy-in and ownership of the management goals;
- Aggressive treatment protocols in Year 1 with follow-up action in subsequent years as needed;
- Diligent monitoring and hand removal of satellite populations;
- Establish a community-led management program in corporation with Thurston County;
- Regular reviews and adaptive changes to management approaches; and
- Continue to identify, evaluate, and apply the best available science.

The preferred management approach incorporates existing manual methods to control satellite populations of milfoil in conjunction with aquatic herbicides approved for use by the Washington Department of Ecology (Ecology) and Thurston County to control yellow iris, fragrant waterlily, and water nymph. More specifically, low concentrations of fluridone will be used to reduce, but not eradicate, nuisance levels of the native submersed water nymph, triclopyr will be used to control fragrant waterlily, and glyphosate to control yellow iris. This approach includes herbicide applications in two consecutive years, with manual controls as needed, followed by manual methods the following three years. The Save Black Lake Coalition recognizes the importance of maintaining a healthy native plant community to support aquatic invertebrates, fish, and to reduce the resuspension of nutrients that may lead to nuisance or even toxic algae blooms.

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WATERSHED AND WATERBODY CHARACTERISTICS

Project Area

Black Lake is located in Thurston County, Washington, four miles southwest of the City of Olympia (Figure 1) in the western part of the Deschutes River Water Resources Inventory Area (WRIA) 13). Black Lake was at one time included in the Upper Chehalis River watershed (WRIA 23) since the natural outlet of Black Lake is the Black River, a tributary to the Chehalis River. The current outlet of Black Lake however, is located at the northern end of lake and flows into Percival Creek, which flows into Budd Inlet (part of WRIA 13).

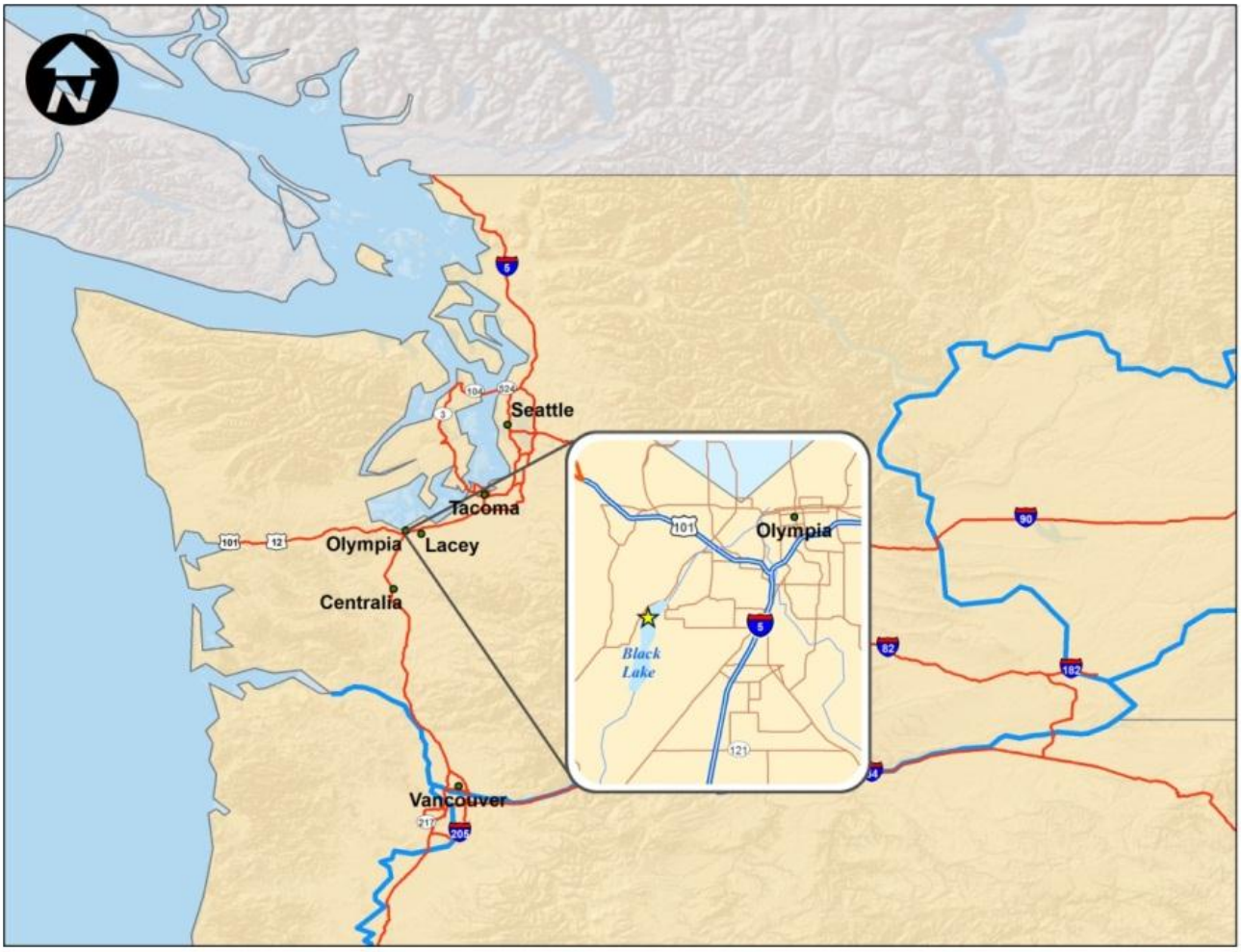
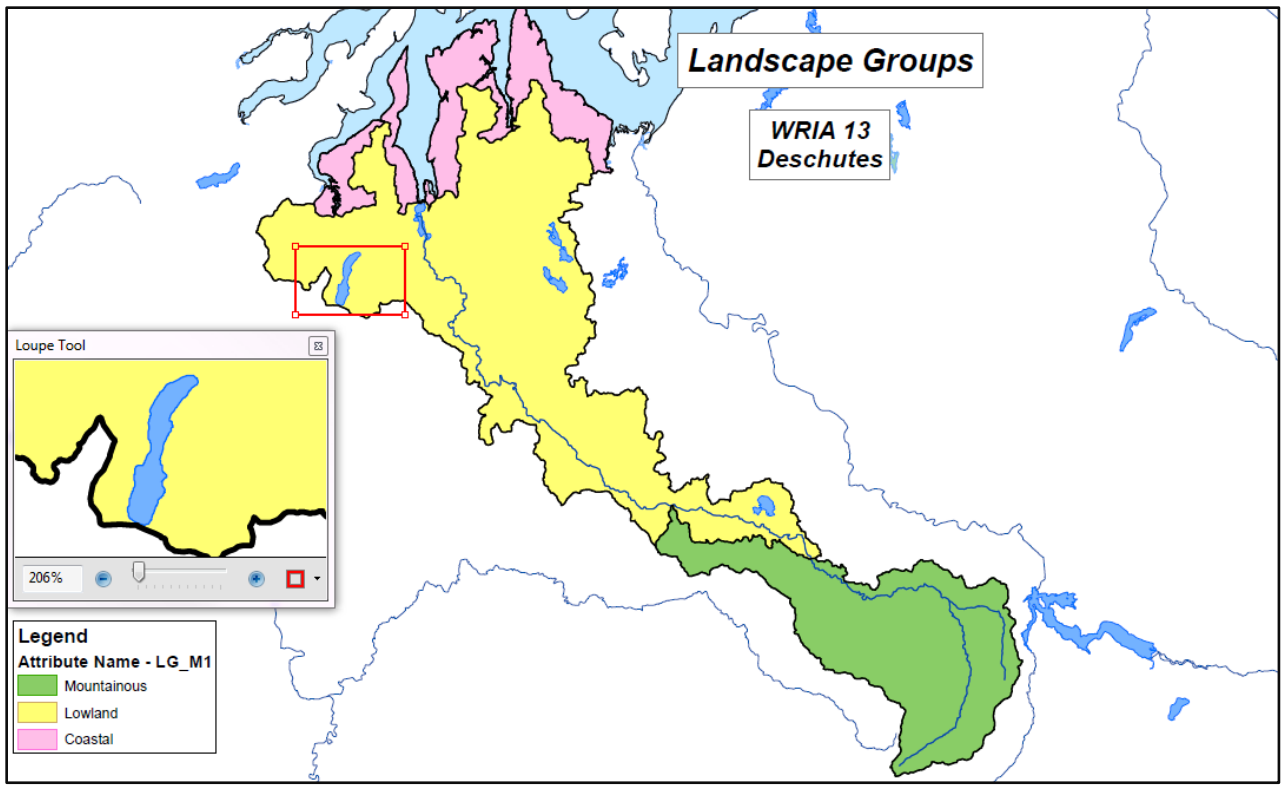


Figure 1. Black Lake Location Map



Source: Puget Sound Characterization Project, 2011, WRIA 13 Analysis Maps for Water Flow in the Deschutes Watershed.

Figure 2. Deschutes Water Resource Inventory Area (WRIA) 13

Is this still accurate?

Land use surrounding Black Lake includes a mix of urban residential and forested areas as well as some urban commercial and a small area of agricultural lands. Most of the population lives in unincorporated areas. A large percentage of the shoreline around Black Lake is moderate density residential. There are two large mobile home parks on the east shoreline and two RV commercial resorts on the west side of the lake.

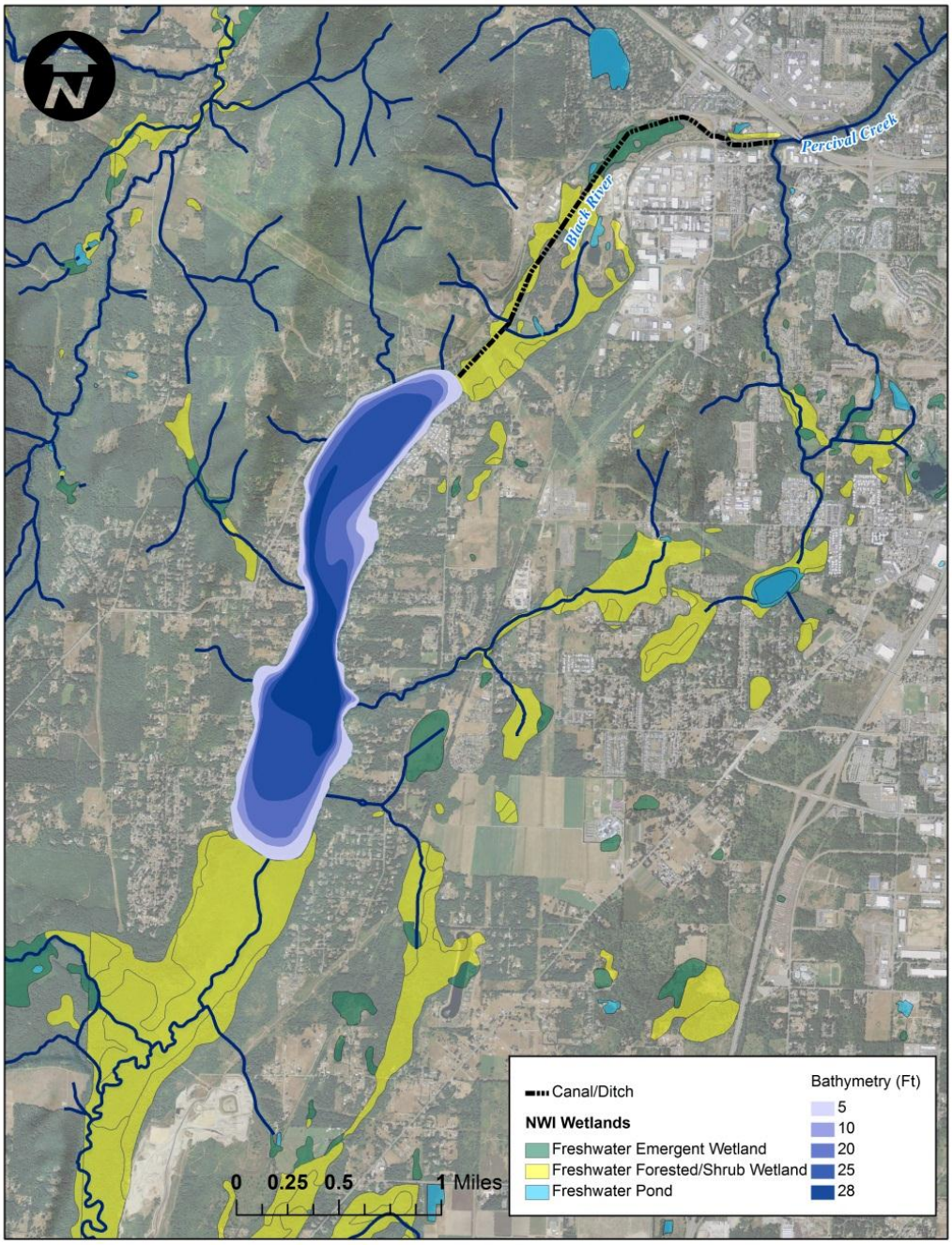
Black Lake is one of the largest lakes in Thurston County, WA. Black Lake has a surface area of 570 acres with a volume of 11,000 acre-ft. The maximum depth is 29 feet with a mean depth of 19 feet. The lake has approximately 6 miles of shoreline. Average annual precipitation in Thurston County is 51 inches.

Black Lake is oriented in a north-south direction with several small creeks flowing into it from the east and west. Two tributaries originate in wetlands on the east side of the lake (Figure 3). On the west side, there is one larger tributary and several intermittent streams that flow into the lake. Traditionally, Black Lake has been thought to be the source of the Black River, and part of the drainage. However, except during flooding, Black Lake drains north into Percival Creek. It is likely that Black Lake is hydrologically connected via groundwater to the Black River. The flushing rate of Black Lake is not known.

Shown as Black River on the map?

Historically the lake outlet was to the south, down the Black River system. However, in 1922 Black Lake Ditch was excavated in order to drain the potential agricultural land north of Black Lake, thus linking Black Lake to Percival Creek. Black Lake Ditch and Percival Creek are located in WRIA 13, the Deschutes River WRIA. The natural lake outlet to the south is now obstructed by numerous beaver dams and vegetation (Thurston County 2010). The series of drainage easements established to provide construction and a permanent maintenance easement for the Black Lake Ditch, in addition to other easements surrounding the Black River at the south end of Black Lake, were combined to establish Black Lake Drainage Ditch District #101. In 1976, Thurston County became the responsible owner of the Black Lake Ditch corridor when Drainage Improvement District #101 was abandoned.

Despite the drainage ditches, there are extensive wetlands around Black Lake (Figure 3). The south and north ends are dominated by extensive wetland systems. Other waterbodies in the vicinity of Black Lake include: emergent and forested/shrub wetlands, ponds, and rivers (namely the Black River, the Deschutes River, and Percival Creek), and small lakes (Capitol Lake, Barnes Lake, Trosper Lake and Ken Lake).



Source: USFWS (2011)

Figure 3. Black Lake Bathymetry, Associated Wetlands, and Tributaries

Beneficial and Recreational Uses

Black Lake supports a variety of beneficial and recreational uses. Protected beneficial uses include swimming, boating, and wildlife habitat (State Water Quality Standards Chapter 173-201 WAC). Common recreational uses include waterskiing, jet skiing, and fishing which occur across the waterbody. Warm water fish species (largemouth bass, smallmouth bass, perch, and crappie), rainbow trout, cutthroat trout, and some large triploid rainbows are popular sport fisheries at Black Lake (WDFW 2011). Public access to Black Lake consists of a Washington Department of Fish and Wildlife (WDFW) public boat launch (Figure 4), Kenneydell County Park (owned by Thurston County), one church camp, two private resorts, and three small private community accesses points. No known drinking/domestic water or irrigation withdrawals or stock watering sites are known to occur around Black Lake (Thurston County 2012).

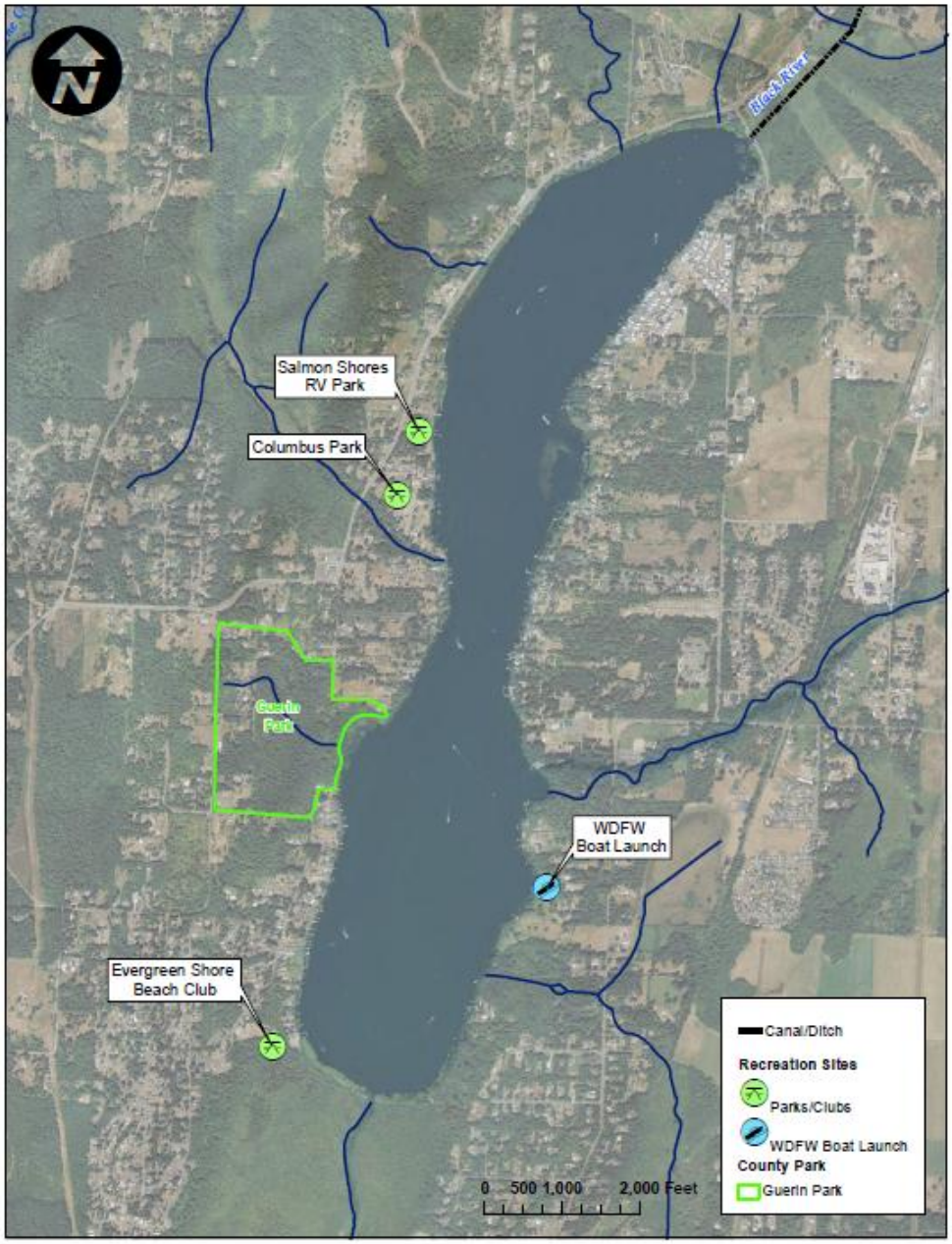


Figure 4. Black Lake Use Map

Water Quality Features

Black Lake has a water quality data record beginning in 1971 that continues through the present. Secchi disk depth data was collected during 1971 as well as in July of 1981 along with very limited water quality information. Thurston County has collected monthly water quality samples from Black Lake since 1992, usually from May through October. Data from 1992 to 2010 show the lake to be of fair quality with moderate to high nutrient concentrations and nuisance algae blooms in the late summer. Summer mean concentrations from 1992 to 2010 for chlorophyll a and surface total phosphorus (TP) were 15.7 µg/L and 28.2 µg/L, respectively. The mean bottom TP concentration for the same time period was 101 µg/L. Surface total nitrogen (TN) averaged 444 µg/L from 1992 to 2010 and bottom TN averaged 485 µg/L for the same time period (Thurston County 2011a).

Thermal stratification occurs in Black Lake in May and usually breaks up at the end of August or beginning of September. The lake is usually completely mixed by October. Dissolved oxygen (DO) concentrations in the lower layer of the lake are very low during July through September and in some years as early as June. The low DO conditions result in a slow release of phosphorus from the lake sediments into the lower water column of the lake. This is why bottom TP concentrations are much higher than concentrations at the surface of the lake. The release of nutrients from the lake sediments stimulates algal productivity in the lake, especially during late summer when the lake mixes. Water clarity in Black Lake has been relatively consistent over the past 19 years with an average Secchi disk depth reading of 2.0 meters (m). Annual Secchi disk depth means ranged from 1.4 m in 1992 to 2.7 m in 2001 (Thurston County 2011a).

The Carlson (1977) trophic state indices (TSI) are used to describe a lake's quality and degree of productivity. TSI values are calculated based on the average summer TP and chlorophyll concentrations as well as the average Secchi disk reading. TSI values of 0 to 40 indicate an oligotrophic lake, 41 to 50 a mesotrophic lake, and greater than 50 a eutrophic lake, or highly productive lake. Black Lake consistently has TSI values ranging from 46 to 65, or from the upper limit of the mesotrophic range into the eutrophic range. Average TSI values from 1992 to 2010 (excluding 1993) for TP, chlorophyll a, and Secchi disk were 52, 57, and 50, respectively; all within the range for a eutrophic lake (Thurston County 2011a).

Algae types commonly present in Black Lake include diatoms, green and blue-green algae or cyanobacteria. During peak phytoplankton production, in the late summer and early fall, cyanobacteria species *Aphanizomenon* and/or *Anabaena* are dominant and are usually responsible for the "algal blooms" frequently seen on the lake. At times algal growth has impaired recreational uses due to poor water clarity, algal scum on the water surface, and odor. This occurred in 1992, 1994, and 2000. In September of 2000, a spectacular cyanobacteria bloom occurred that covered much of the western shore of the lake. In 2004, 2006, and 2007 less dramatic algae blooms occurred and advisory signs were posted in swimming areas at the Kenneydell County Park on the eastern shore of the lake (Thurston County 2010). Cyanobacteria blooms can produce toxins that can cause illness or even depth in people, pets, and wildlife. In 2009 Thurston County Environmental Health purchased test kits to screen lake samples for the presence of the most common cyanobacteria toxin.

Cyanobacteria blooms are known to occur on Black Lake as recently as the summer and fall of 2010 and fall of 2011. Samples collected from Black Lake in September 2010 contained the cyanobacteria toxin Microcystin at levels high enough to warrant posting warning signs at swimming beaches and boat launches. Microcystin continued to be present in samples collected through October and November, with a peak concentration 167 µg/L on October 12, 2010 (TAD 2011). Microcystin was found in Black Lake at the end of September 2011 at a concentration of 13.9 µg/L. This concentration warranted the posting of warning signs at swimming beaches and boat launches advising lake users to avoid contact with lake water and to keep pets and livestock away. Another cyanobacteria bloom was confirmed on Black Lake on October 5,, 2011. Samples collected from the most recent blooms have been sent to the King County Environmental Laboratory for analysis of Microcystin and Anatoxin-a.

Update this info

Adjacent wetlands and the shallow groundwater system likely have an influence on water quality characteristics of Black Lake. Septic systems around the lake also most likely influence Black Lake water quality. Figure 5 shows septic system locations within the Tumwater area and Black Lake. Based on this information, residential homes around Black Lake currently have no sewer service and rely on septic systems. This potentially has the impact of

increase nutrient loading to the lake, both nitrogen and phosphorus, that can adversely increase the rate of eutrophication. Evidence for this is the increasing frequency and intensity of cyanobacteria blooms and excessive growth of vascular rooted submersed plants that are negatively impacting beneficial uses of the lake. Other major nutrient sources include adjacent land uses and subsequent stormwater runoff that also carry nutrients to the lake.

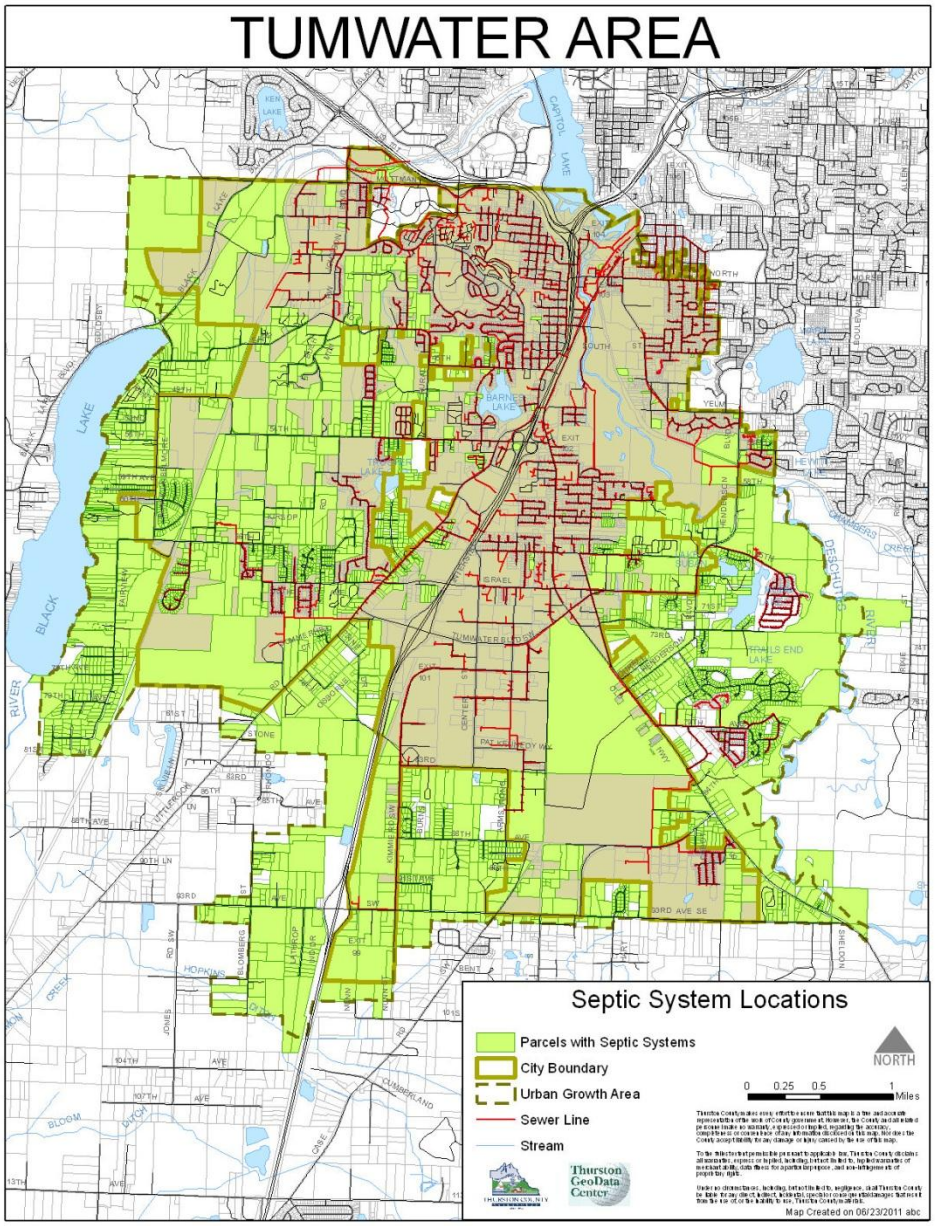
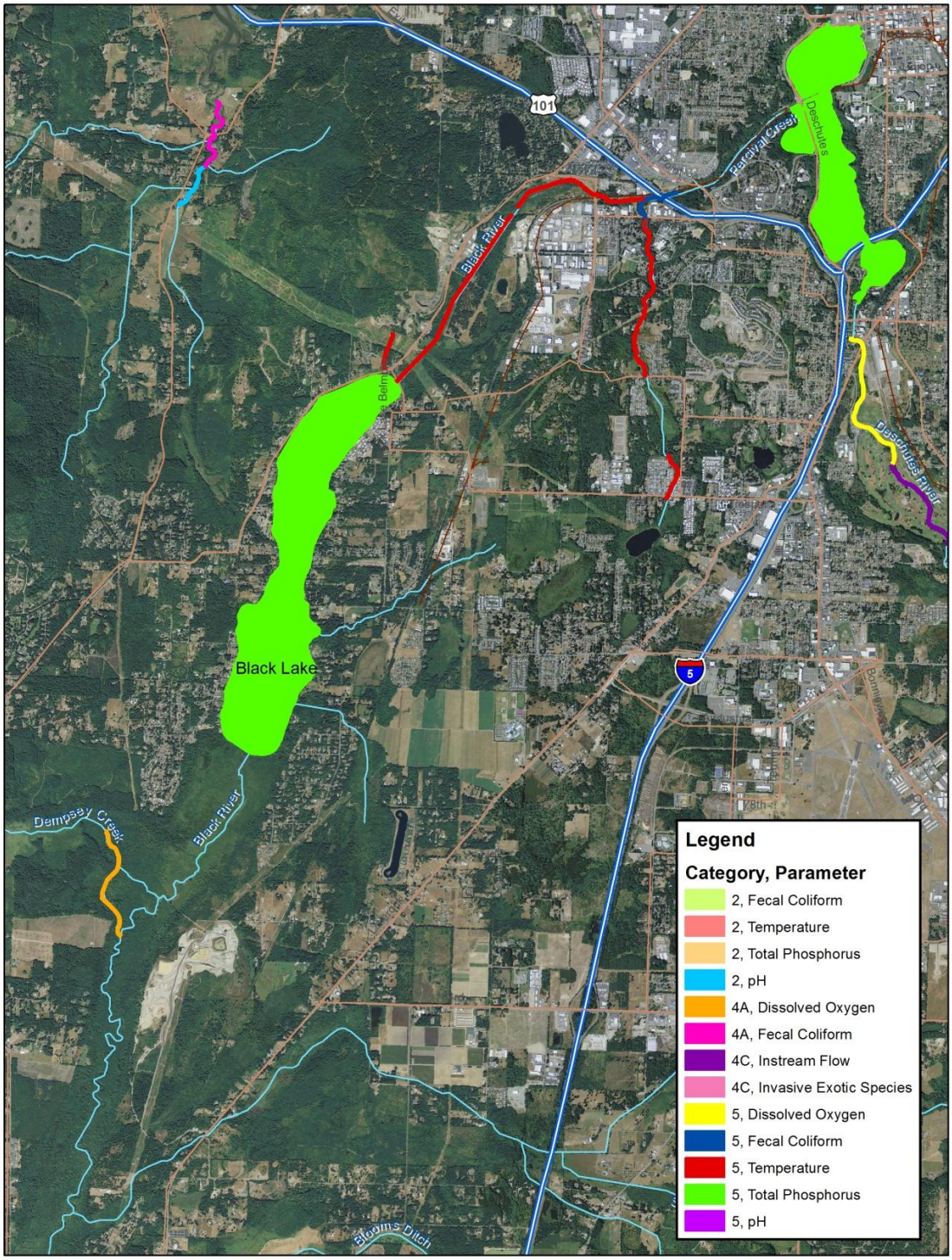


Figure 5. Septic System Locations in the Vicinity of Black Lake

Update

Black Lake is listed under Category 5 in the 2008 Water Quality 303(d) assessment for total phosphorus (Figure 6). Black Lake Ditch is listed as a Category 5 waterbody for DO, temperature, and pH in the 2008 303(d) assessment. Black Lake ditch is also listed as a Category 2 waterbody for fecal coliform. Percival Creek, which is linked to Black Lake via the Black Lake Ditch, is listed as a Category 5 waterbody in the 2008 303(d) assessment for temperature, DO, and fecal coliform and as a Category 1 waterbody for pH (Figure 6). It is not anticipated

that management approaches identified later in this IAVMP will further impact existing designations; in fact, the purpose of this plan is to substantially improve the condition of Black Lake by controlling nuisance growth of aquatic plants.

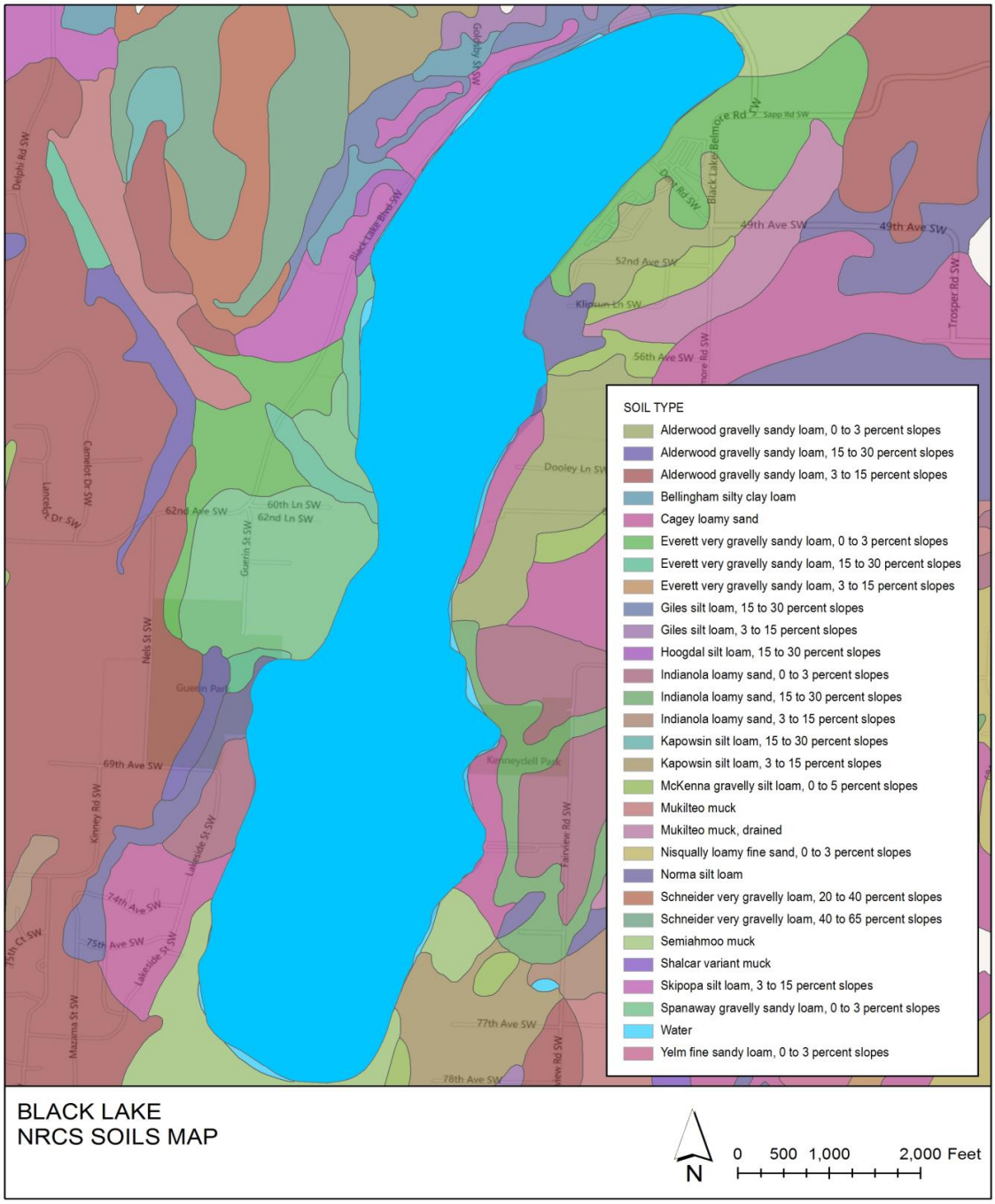


Source: Ecology 2008

Figure 6. 2008 Water Quality Assessment 303(d) Waterbodies

Sediment Characteristics

Primary soils in the vicinity of Black Lake are composed of gravelly sandy loam, loamy sand, and silt loam (USDA-NRCS 2012) (Figure 7). Alderwood gravelly sandy loam, 3 to 15 percent slopes dominates the area. These soils occur in areas between 50 to 800 feet in elevation with mean annual precipitation of 25 to 60 inches. They are found in tilled plains and are moderately well drained. Cagey loamy sand is also quite common. These soils occur in areas receiving between 40 to 60 inches of rain annually in terraced landforms of sandy glacial drift. Cagey loamy soils are moderately well drained. Indianola loamy sand, 0 to 3 percent slopes occur in areas receiving between 30 to 55 inches of rain annually in terraced, eskers, or kames landforms of glacial sandy drift. Indianola sandy loam soils are somewhat excessively drained. Kapowsin silt loam, 3 to 15 percent slopes occur in areas between 50 to 900 feet in elevation with mean annual precipitation of 30 to 50 inches. They are found in tilled plains and are moderately well drained.



Source: USDA-NRCS (2012)

Figure 7. USDA Custom soil Resource Report

Biological Features

Aquatic Plant Characteristics and Distribution

Nearly 40 species of submersed and emergent plant species are known to occur in Black Lake (Ecology 2011a; Thurston County 2001b) (Table 1). Of particular concern is the presence of non-native Eurasian watermilfoil (*Myriophyllum spicatum*), yellow iris (*Iris pseudacorus*), and fragrant waterlily (*Nymphaea odorata*), as well as the native water nymph (*Najas flexilis*) and spatterdock (*Nuphar l polysepala*).

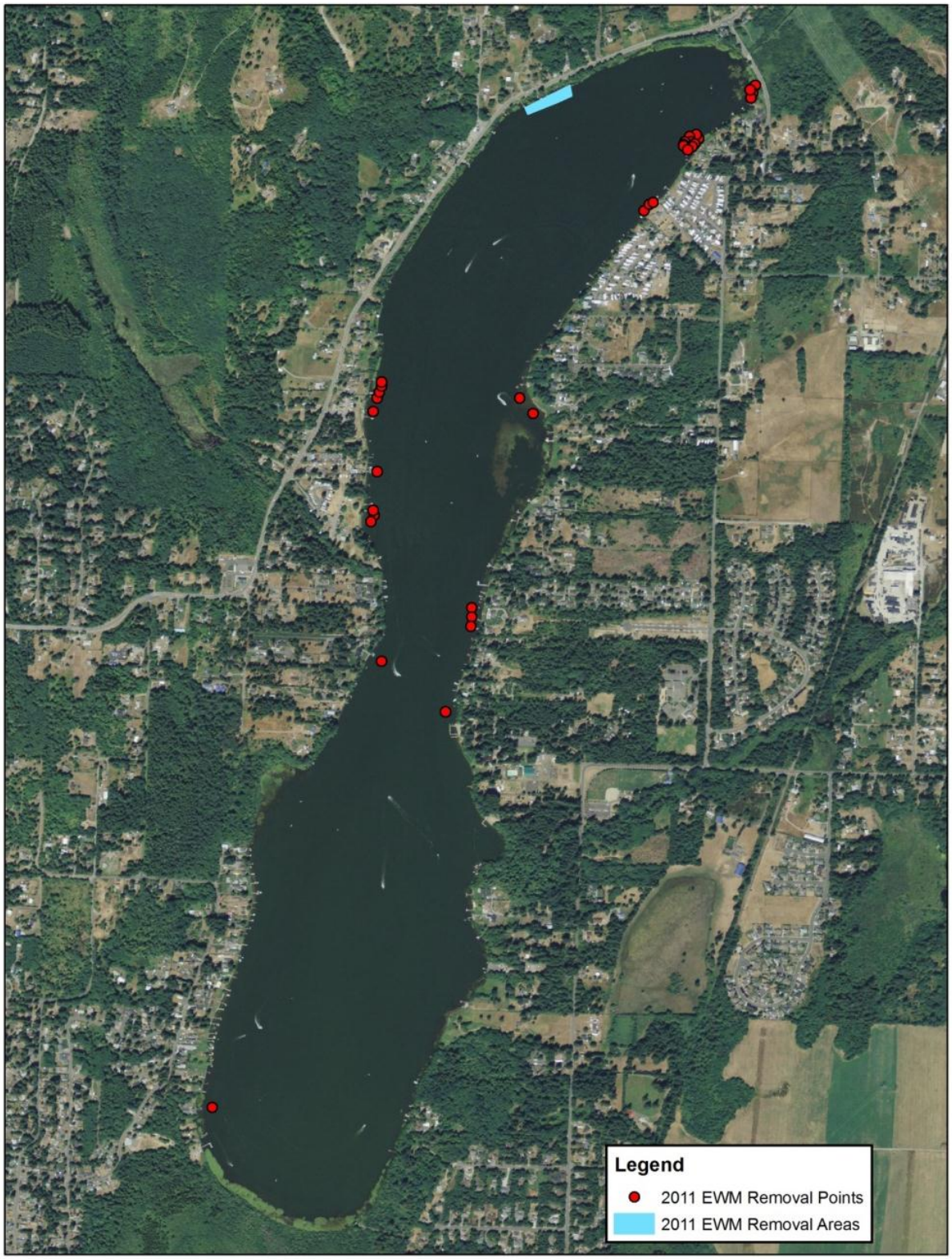
Milfoil

First introduced to the U.S. from Europe in the 1940s, Eurasian watermilfoil (milfoil) is now the most widespread submersed aquatic weed in the northern U.S. (Madsen 2009). Milfoil is capable of growing in up to 30 feet of water but typically grows in 1 to 15 feet. Though milfoil produces flowers and seeds, it primarily spreads by stem fragments that can produce new roots and root crowns. The starch-rich stems and root crowns of milfoil allow it to overwinter and survive long periods in the water or sediment. Fragments are commonly created mechanically by boat props; however, milfoil natural fragments as part of its lifecycle.

Eurasian watermilfoil (Figure 8) is a Class B noxious weed in Washington (Washington State NWCB 2011), meaning prevention and containment are the primary goals (WAC 16-750-04). Species are "designated" for control at the local level (by region). Milfoil is non-designated in Region 5 (which includes Thurston County). Milfoil was discovered in Black Lake in 2004 and was later confirmed by DNA analysis in 2005 (Johnson 2009). The Thurston County Noxious Weed Control Agency has been surveying Black Lake annually since the DNA identification. Every year the Thurston County Noxious Weed Control Agency conducts a complete and thorough survey of Black Lake, from 0 to 10 feet in depth. All Eurasian watermilfoil plants discovered are mapped and removed for diver hand removal or the placement of bottom barriers. Figure 9 shows the locations where Eurasian watermilfoil was discovered and removed in Black Lake during 2011.



Figure 8. Eurasian Watermilfoil



Source: Janie Civille, Thurston County

Figure 9. Milfoil Survey Locations and Removal Points/Areas in Black Lake, 2011

Yellow iris

Yellow iris is an emergent perennial found along the margins of lakes, ponds, and streams. The showy yellow flowers of yellow iris are common along shorelines and wetlands of Washington during the later spring or early summer. When not in flower, it can be confused with cattails (*Typha* sp.) or broad-fruited bur-reed (*Sparganium eurycarpum*). It is a valued horticultural plant that has escaped cultivation and become established across much of the U.S. and Canada.

Yellow iris reproduces by both seed and vegetative structures. Seeds that are produced in the fall and early spring float along watercourses and germinate in moist soil when the water recedes or seeds become lodged. Rapid root development allows young seedlings to establish on a variety of substrates (e.g., tree roots, river debris) and readily adapt to fluctuating water levels. Rhizomes that become fragmented during disturbance or floods are moved by currents to spread the infestation. Even dry rhizomes are reportedly viable for three months (Sutherland 1990). The depth distribution of yellow iris is roughly 2.5 to 3 ft. (Preece 1964; Tanner et al. 1990). Resin in the leaves and rhizomes of yellow iris are a known skin irritant. Care should be taken when hand-pulling plants.

Yellow iris is listed as a Class C noxious weed in Washington (Washington State NWCB 2011), meaning counties may choose to either enforce its control or to provide education or technical support for its removal or control. Results of Thurston County's 2011 survey found a total of about 0.21 acres of yellow iris along the shoreline of Black Lake (Figure 10).

Fragrant waterlily

Fragrant waterlily is a very popular and prized ornamental flower made popular by the horticulture industry. Through hybridization, there are numerous white to pinkish color variations common in backyard ponds and now in the environment where they are widely naturalized. Fragrant waterlily is considered native to the eastern U.S. and likely introduced to Washington during the Alaska Pacific Yukon Exposition in Seattle in the late 1800s (Ecology 2011b).

Fragrant waterlily grows along the shoreline of lakes and rivers. It is rooted in the sediment and its stems and flowers grow to the water surface, forming a lily pad. They commonly grow in dense patches such that leaves cover the entire surface of the water - limiting light for other submersed aquatic plants and can depleting oxygen needed for aquatic invertebrates and fish. Like many nuisance aquatic species, fragrant waterlily limits shoreline access, watercraft movement, swimming, and fishing. Spread of fragrant waterlily occurs by rhizome and seed production. Even small fragments of its rhizome can produce additional plants. Given the plant's striking flowers, it is no surprise fragrant waterlily spreads by seed; however, the mechanism is one of the more interesting with respect to aquatic plants. The flowers are only open during the day when pollen-covered insects are attracted to the flower and fall into a fluid-filled center of the flower where fertilization occurs. The flower is only receptive to pollen the first day of flowering, and in fact, within three days pollen is released from the flower and again becomes submersed. Mature seeds are released and spread by water currents or waterfowl that consume the seeds (Ecology 2011b).

Results of Thurston County's 2011 survey found a total of about 3 acres of fragrant waterlily along the shoreline of Black Lake with nearly 28 acres of mixed community bed dominated by fragrant waterlily (Figure 10).

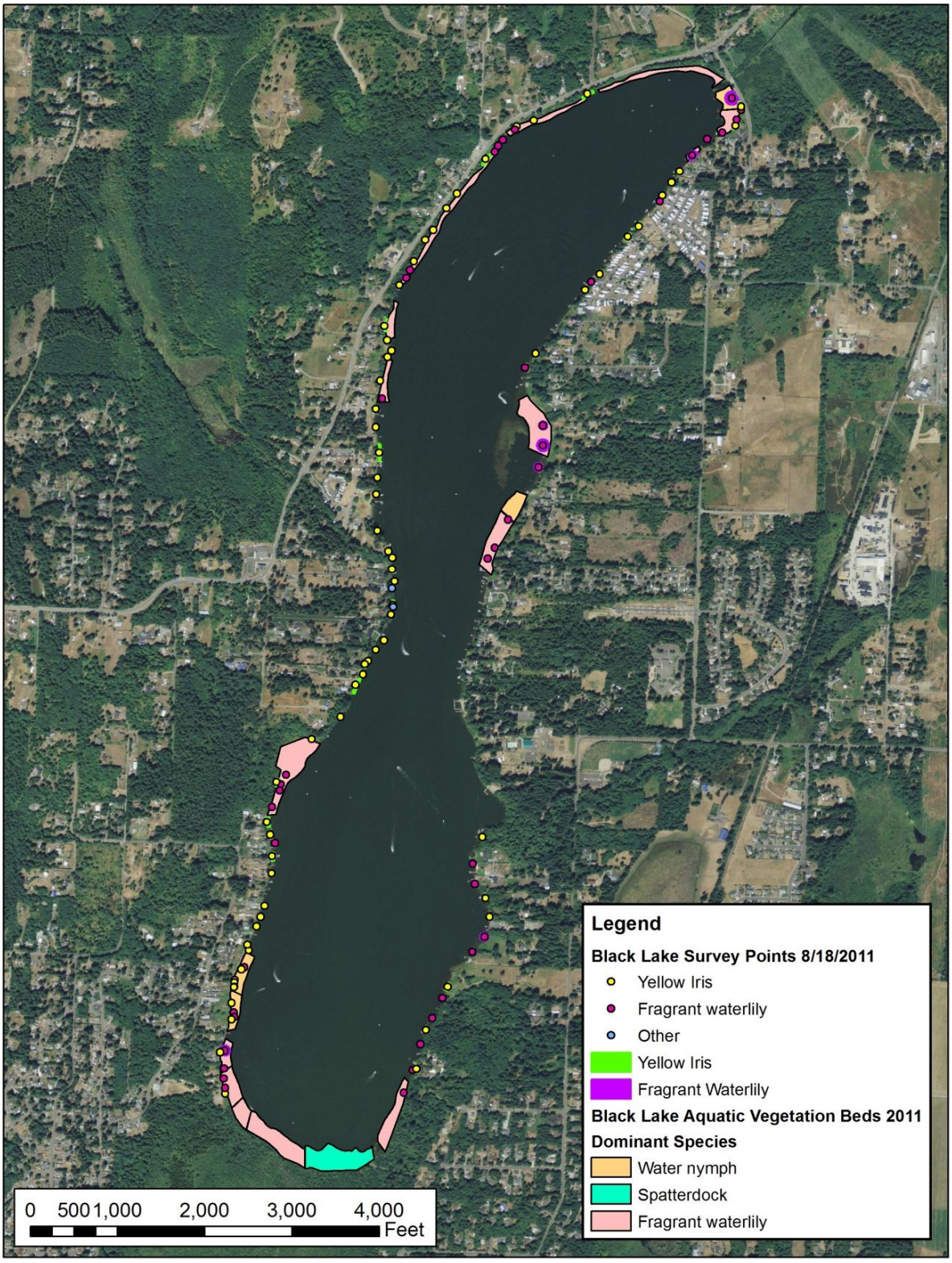
Water nymph

Water nymph (also commonly referred to as naiad) is native to North America and is common in many ponds and lakes in Washington. It is a completely submersed plant with very inconspicuous flowers tucked in the leaf bases. Water nymph spreads by seeds and plant fragments and commonly grows to 20 feet or more. Though water nymph is native to Black Lake, it has become increasingly problematic for lakefront residents and water users. It grows to about 25 feet in Black Lake where it dominates much of the southern, middle, and northern portions of the lake. In 2006, it covered approximately 201 acres of the lake bottom (Thurston County

Noxious Weed Control Agency 2011a). In 2011, water nymph did not generally reach the lake surface or produce a canopy as much as it had in previous years; with nuisance populations only in a small portion of the lake in 2011 (Figure 10). However, water nymph was observed on the majority of the lake bottom during the annual milfoil surveys in 2011 (Thurston County Noxious Weed Control Agency 2011b). In deeper water, it may be displacing other natives such as Richard's pondweed (*Potamogeton richardsonii*) (Thurston County 2011b). The dominance of this plant community and the intensity of growth are due to several factors that vary from year to year, hence the variation in both aerial coverage and plant height. However, given this plant's overall dominance of the lake bottom, it is most likely that the plant is responding to excess nutrient availability from surface, subsurface and sediment loading of nitrogen and phosphorus.

Spatterdock

Spatterdock (also commonly referred to as yellow pond-lily or yellow cow-lily) is also native to western North America and common to many shallow lakes and ponds in Washington. Like fragrant waterlily, it is rooted with leaves that grow to float on the water surface as a lily pad. Spatterdock flowers are bright yellow and cup-shaped. When not in flower, they may be confused with fragrant waterlily; however the leaves are more heart-shaped than rounded. Though spatterdock can grow to nuisance levels, it is a food source for mammals and waterfowl and provides spawning habitat for some fish species (Ecology 2001). Spatterdock spreads by both rhizomes and seeds. In Black Lake, spatterdock covers a total of about 4 acres in mixed community beds in the southern portion of the lake.



Source: Janie Civille, Thurston County

Figure 10. Other Aquatic Plant Survey Locations in Black Lake, 2011

Table 1. Aquatic plants known to occur in Black Lake.

Scientific name	Common name	Native (Y/N)
Alisma triviale	American water-plantain	Y
Brasenia schreberi	watershield	Y
Carex sp.	sedge	Y
Ceratophyllum demersum	Coontail; hornwort	Y
Ceratophyllum sp.	coontail	Y
Comarum palustre	purple (marsh) cinquefoil	Y
Eleocharis sp.	spike-rush	Y
Elodea canadensis	common elodea	Y
Elodea nuttallii	Nuttall's waterweed	Y
Elodea sp.	waterweed	Y
Equisetum sp.	horse tail	Depends on species, likely native
Impatiens sp.	jewelweed	Depends on species, likely native
Iris pseudacorus	yellow iris	N; Class C Noxious Weed[a]
Juncus sp.	rush	Depends on species
Lysimachia nummularia	creeping loosestrife	N
Mentha sp.	mint	Depends on species
Myriophyllum spicatum	Eurasian watermilfoil	N
Myosotis sp.	forget-me-not	Depends on species
Najas flexilis	common naiad	Y
Najas sp.	water-nymph	Y
Nitella sp.	stonewort	Y
Nuphar polysepala	yellow water-lily	Y
Nymphaea odorata	fragrant waterlily	N; Class C Noxious Weed[a]
Phalaris arundinacia	reed canarygrass	N; Class C Noxious Weed[a]
Polygonum cuspidatum	Japanese knotweed	N
Potamogeton amplifolius	large-leaf pondweed	Y
Potamogeton epihydrus	ribbonleaf pondweed	Y
Potamogeton praelongus	whitestem pondweed	Y
Potamogeton richardsonii	Richardson's pondweed	Y
Potamogeton sp (thin leaved)	thin leaved pondweed	Depends on species, likely native
Schoenoplectus acutus	hardstem bulrush	Y
Schoenoplectus sp.	naked-stemmed bulrush	Depends on species
Spiraea douglasii	spiraea, hardhack	Y
Spiraea sp.	spirea	Depends on species, likely native
Typha latifolia	common cat-tail	Y
Typha sp.	cat-tail	Depends on species
Utricularia vulgaris	common bladderwort	Y

Data Sources: Ecology (2011a) and Thurston County (2011b)

[a]Class C noxious weeds are either already widespread in Washington or are of special interest to the agriculture industry

Fish and Wildlife

Fish species known to occur in Black Lake are shown in Table 2. The lake provides a diverse habitat for largemouth bass, including old submersed logs, overhanging and shoreline vegetation. Manmade structures such as pilings, docks, and floats also provide habitat.

Table 2. Fish Composition at Black Lake

Scientific name	Common name	Native (Y/N)
Micropterus salmoides	largemouth bass	N
Lepomis gibbosus	pumpkin seed sunfish	N
Ameiurus nebulosus	brown bullhead catfish	N
Ambloplites repestris	rock bass	N
Lepomis macrochirus	bluegill	N
Oncorhynchus clarki	cutthroat trout	Y
Oncorhynchus mykiss	rainbow trout	Y
Oncorhynchus tshawytscha	Chinook salmon	Y; landlocked
Perca flavescens	yellow perch	N
Pomoxis nigromaculatus	black crappie	N

Species of Concern in the Vicinity of Black Lake

Update

The Washington Department of Natural Resource (WDNR) Natural Heritage Program (WDNR 2010) indicates the occurrence of two species listed by the USFWS and/or WDFW that are known to occur within a 20 mile radius of Black Lake. Howellia (*Howellia aquatilis*) is federal and state threatened and dense sedge *(Carex densa*) is state threatened. Neither species, however, are reported to occur within two miles of Black Lake (Figure 11). Bristly sedge (*Carex comosa*) is state sensitive in Washington and occurs within a mile of Black Lake (Figure 11).

The Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species (PHS) database (WDFW 2011) indicates waterfowl concentrations, specifically occurrences of wood duck (*Aix sponsa*) and green heron (*Butorides virescens*) in the wetlands south of Black Lake. On the western side of the lake are communal roosts for little brown myotis (*Myotis lucifugus*) and Yuma myotis (*Myotis yumanensis*), bald eagle (*Haliaeetus leucocephalus*) breeding areas, an occurrence of Olympic minnow (*Novumbra hubbsi*) in the central tributary. Communal roosts for little brown myotis and Yuma myotis extend around the northern portion of the lake as well. On the east side of the lake, coast resident cutthroat (*Oncorhynchus clarki*) is identified in the tributary adjacent to Kennydell County Park and the unnamed tributary to the south of the Black River.

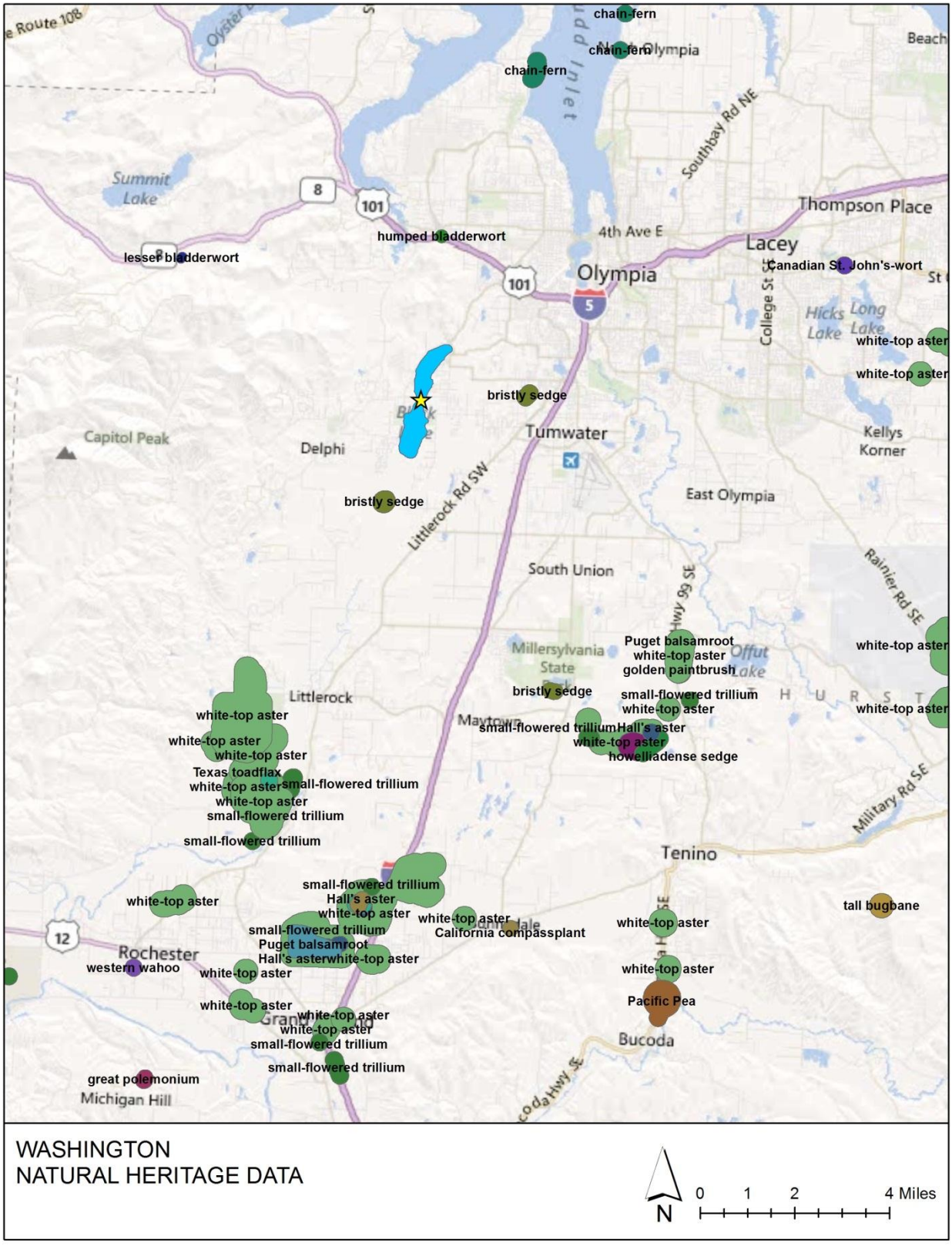


Figure 11. Location of Special Status Plant Species in the Vicinity of Black Lake

PROBLEM STATEMENT

Update

The presence of milfoil is common to many lakes throughout Washington and the Pacific Northwest where its growth limits recreation, navigation, disrupts natural water flow, and adversely impacts aquatic habitat and water quality. To date, hand pulling has been employed to control plant density in Black Lake by physically removing plants. This method of control has prevented the rapid expansion of both the area covered and density potential of this nuisance plant (Figure 7). The non-native yellow iris and fragrant waterlily as well as the native water nymph and spatterdock are also adversely impacting the ecological balance of the lake and its beneficial uses (Figure 8). Not only are all parts of yellow iris poisonous, causing skin irritation, but the plant forms dense colonies that alter shoreline and aquatic habitat. The fragrant waterlily can grow to nuisance densities and, in response to high nutrient availability, accelerate nutrient over-enrichment of a water body.

Dense growth of water-nymph is a likely a response to the lake's nutrient supply as it forms some dense colonies that directly impacts some recreational uses. On the other hand, water-nymph provides direct aquatic habitat benefits to fishes and invertebrates and is an important food source for waterfowl. The plant also serves to balance the primary production in the lake by providing direct and indirect competition for nutrients versus the cyanobacteria (blue-green algae) that also have produced blooms in the lake. Spatterdock also provides aquatic habitat and is a direct food source for aquatic biota, but its current coverage is not presenting a nuisance relative to the beneficial uses of the lake.

The purpose of the Black Lake Integrated Aquatic Vegetation Management Plan (IAVMP) is to develop a long-term adaptive strategy to eradicate non-native aquatic plants and manage expanding densities of nuisance native species from Black Lake. This adaptive strategy will provide an ecologically balanced way to maintain and improve existing beneficial and recreational uses to meet future water resources needs and ecosystem demands.

COMMUNITY INVOLVEMENT

I think the SBLC has been replaced by the BLSD

The Save Black Lake Coalition is a non-profit organization made up of Black Lake residents dedicated to keeping the lake clean of invasive species and improving water quality. In particular, this grassroots organization works as a community to sustainably and effectively manage existing populations of nuisance vegetation while striving to maintain water quality and reduce nuisance algae blooms. The Save Black Lake Coalition has worked very closely with the Thurston County Resource Stewardship Department. The Coalition also maintains a website and email list to provide up to date information.

Two public meetings were held in facilitate development of the Black Lake IVAMP. The first meeting was held September 22, 2011 at the Black Lake Bible Camp and attended by approximately 50 community members. At that meeting Tetra Tech staff provided an overview of the problems associated with invasive aquatic plants along with the pros and cons of various physical, biological, mechanical, and chemical control methods. Four alternative approaches for eradicating non-native species from Black Lake was presented and citizens came to consensus on the problem statement and the best approach to meet their management goals. A second public meeting was held October 11, 2011 and was similarly attended by approximately 50 community members who concurred with the draft plan as presented. Announcements for public meetings and supporting materials (e.g. PowerPoint slides, newspaper articles) were posted on the Save Black Lake Coalition website (http://www.saveblacklake.org). A timeline for the development and implementation of the Black Lake IAVMP is provided in Table 3.

Table 3. Schedule for the Development and Implementation of the Black Lake IAVMP

	Aug 2011	Sept 2011	Oct 2011	Nov 2011	Dec 2012
Vegetation Mapping	x				
Public Meetings		22nd	11th		
Materials for the Save Black Lake Coalition Website/Newsletter			x		
Draft Black Lake IAVMP submitted to Ecology			x		
Apply for Aquatic Plant Management Grant through Ecology			x		
Respond to comments and submit Final Black Lake IAVMP submitted to Ecology				x	
Apply to Ecology for Aquatic Plant & Algae Management General Permit					x
Implement Year 1 Recommendations upon plan approval and funding					

MANAGEMENT GOALS

Eradicate is hard to confirm

The overarching management goal of the Black Lake IAVMP is to provide citizens of Black Lake and Thurston County the guidance and understanding to efficiently and effectively *eradicate* non-native milfoil, fragrant waterlily, and yellow iris from Black Lake. The IAVMP will also provide for the balanced management of native plants particularly water-nymph. Additionally, the management approach identified in this IAVMP will maximize the beneficial uses of Black Lake and maintain water quality, recreation, fish and wildlife habitat, and aesthetics. Successful eradication will require a multi-year, aggressive, and dedicated management strategy.

Short-term Goals

- Community buy-in and ownership of the management goals
- Aggressive treatment protocols in Year 1 with follow-up action in subsequent years as needed
- Diligent monitoring and hand removal of satellite populations

Long-term Goals

- Establish a community-led management program in corporation with Thurston County
- Regular reviews and adaptive changes to management approaches
- Continue to identify, evaluate, and apply the best available science

AQUATIC PLANT CONTROL ALTERNATIVES

Information on aquatic plant control alternatives was derived various sources including: Washington Department of Ecology (http://www.ecy.wa.gov/programs/wq/plants/management/index.html), *A Citizen's Guide for Developing Integrated Aquatic Vegetation Management Plans* (Gibbons et al. 1994), *Biology and Control of Aquatic Plants: Best Management Practices Handbook* (Gettys et al. 2009), the WDFW "pamphlet" (Pub. # APF-11-97), Thurston County's Integrated Pest Management approaches, field-based experience of the authors, and peer or gray literature otherwise cited in the text. The following sections outline the various methods to control aquatic plants, including: background information, advantages/disadvantages, permit information, costs, and a discussion of the method's appropriateness to Black Lake.

Environmental Manipulation

Water Level Control

Lowering the water level, also known as drawdown, exposes plant stems and other plant propagules to freezing and drying conditions over a prolonged period of time typically during the winter. This may only be used where water levels can be controlled by a dam, siphoning, or pumping and where impacts to native plant and animal species are limited. In some cases, water level controls may already be incorporated into routine maintenance plans (e.g. dock or embankment repair).

Advantages

Provided that the infrastructure exists, water level control it is typically a relatively inexpensive method to control unwanted aquatic vegetation. This is particularly true for species that primarily spread by vegetative propagules that are particularly vulnerable to prolonged desiccation and/or freezing.

Disadvantages

In western Washington, where the temperate climate is buffered by Puget Sound, control of nuisance aquatic plant growth has been less consistent compared to other regions where the winter temperatures are lower and there is less precipitation. Additionally, repeated water level drawdowns can result in sediment compaction that may limit the growth of invasive as well as non-native plant species and can be detrimental to fish spawning habitat. In fact, water level drawdowns can actually promote the growth of invasive plant species due to loss of competitive vigor by native plant species.

Permits

Not Applicable

Costs

Again, provided the infrastructure is in place, the cost of altering water levels is relatively inexpensive. However, where applicable, there may be less direct costs associated with loss of hydropower generation, recreational revenue, or real estate values.

Appropriateness to Black Lake

As with other western Washington reservoirs, this strategy has likely reduced the late spring/early summer growth of milfoil that may be observed in natural lakes, however, it has not resulted in substantial declines in milfoil across the lake by the end of summer. Despite this, the use of water level control, in cooperation with other control methods, may decrease the cost and time associated controlling invasive aquatic plants in Black Lake. In general, however, water level drawdown impacts plants that spread vegetatively rather than those that

spread by seed. In fact, water level drawdown can actually increase the biomass of plants that spread by tubers (carbohydrate-filled reproductive structures).

Biological Control Methods

Biological control is the intentional use of natural enemies such as fish, insects, or disease-causing pathogens to reduce the biomass of a specific nuisance species. Ideally, the agent will be species-specific, attacking a single organism (Gettys et al. 2009). Biological control agents are often imported from its native range after extensive research and after approval by the U.S. Department of Agriculture (USDA). In some circumstances, biological control agents are native and shift their feeding preference from a native species to a closely related non-native species. Some factors that determine the success of a biological control agent include: environmental conditions, food preference, food quality, and stocking rate.

Grass Carp

Grass carp or white amur (*Ctenopharyngodon idella* Val.) are non-native, plant consuming fish native to large rivers of China and Siberia. Known for their high growth rates and wide range of plant food preference, these fish can control certain nuisance aquatic plants under the right circumstances. Grass carp are most appropriately used for lake-wide, low-intensity control of submersed plants. Stocking rates and control success are dependent on climate, water temperature, salinity, dissolved oxygen content in the water, and type and extent of plant species.

Control Effectiveness and Duration

Effectiveness of grass carp in controlling aquatic weeds depends on feeding preferences, metabolism, temperature, stocking rates, and even fish size (Sanders et al. 1991, Ecology, 1992; Cooke et. al., 1993, Colle 2009). Triploid grass carp exhibit distinct food preferences which can vary from region to region. Laboratory and field studies in Washington State have shown that some plant species appear to be highly preferred such as the pondweeds, (e.g. *Potamogeton crispus*, *P. zosteriformes, and Stuckenia pectinatus*); others are variably preferred such as coontaill (*Ceratophyllum demersum*) and Brazilian elodea (*Egeria densa*), and some plants are not preferred such as milfoil, watershield (*Brasenia schreberi*) and cattail (*Typha* spp.). In fact, while grass carp will consume almost any plant material (including grass clippings), there is a conspicuous lack of preference for milfoil (Colle 2009). For example, grass carp were stocked in a Florida reservoir so preferentially fed on hydrilla that the milfoil population increased (Colle 2009). While the invasive milfoil is apparently not a highly preferred food type, especially where other more desirable plants are available, effective grazing on milfoil has been demonstrated in the Northwest several years after implantation (Bonar et al. 1993, Gibbons and Gibbons unpublished data 1994). The duration of aquatic plant control by grass carp is typically 10 years, depending on the age of stocking; however, they are known to survive up to 25 years and are not easily removed after stocking (Gettys et al. 2009).

Advantages

Depending on the problem plant species and other site constraints previously described, proper use of grass carp can achieve long-term reductions in nuisance growth of vegetation. In some cases, introduction of grass carp results in improved water quality conditions (e.g. nitrogen, phosphorus, chlorophyll, dissolved oxygen) and biological condition (phytoplankton, zooplankton, benthic invertebrates) (Thomas et. al., 1990, KCM 1997). Compared to other long-term aquatic plant control techniques (e.g. bottom barriers), costs for grass carp implantation are relatively low.

Disadvantages

Since sterile grass carp exhibit distinct food preferences, they do not graze all plants equally, limiting their applicability. The fish may avoid areas of the waterbody experiencing heavy recreational use, resulting in less plant removal. Plant reductions may not become evident for several years. Mature waterlilies (*Nuphar* and *Nymphaea* spp.) do not appear to be effectively grazed by grass carp. Overstocking of grass carp could result in eradication of beneficial plants and have serious impacts on the overall ecology of the waterbody. An escape

barrier on the outlet (if present) is required to prevent movement of fish out of the system and avoid impacts on downstream aquatic ecosystems. There may be fish loss due to predation, especially by ospreys and otters.

Permits

Grass carp stocking in a private waterbody requires a stocking permit from the WDFW. The stocking permit is a two-step process involving the submission of an Application for Planting Triploid Grass Carp and a Fish Transport Application. Department of Natural Resources Natural Heritage Program must be contacted for an assessment of threatened or endangered plant species. If requested by WDFW, a State Environmental Policy Act (SEPA) Grass Carp Checklist may be required with the stocking permit. Stocking grass carp in a public waterbody also requires Phase I Lake Restoration Study.

If the waterbody (public or private) flows to another body of water, the outflow must be screened which requires Hydraulic Project Approval (HPA) from WDFW. To obtain HPA, a Joint Aquatic Resources Project Approval (JARPA) will need to be completed. These documents may be downloaded at:
http://www.wdfw.wa.gov/fish/trnsport.htm

For approval of all grass carp permits, WDFW regulations require that:

1) Only sterile (triploid) fish can be planted
2) All grass carp be certified disease free
3) Outlets (and possibly inlets) must be screened to prevent fish from getting into other waterbodies
4) Stocking rate will be defined by WDFW based on the current planting model

Costs

The Washington Department of Fish and Wildlife (WDFW) determine the appropriate stocking rate for each waterbody when they issue a grass carp stocking permit. Stocking rates for Washington lakes generally range from nine fish per vegetated acre up to 25 fish per vegetated acre (based on 8 to 11 inch fish). This number will depend on the amount and type of plants in the lake as well as spring and summer water temperatures. However, WDFW generally errs on the side of stocking the least amount of grass carp possible. Based on the few large-scale grass carp implantations made in Washington since 1990, costs can range from approximately $50/acre to $1000/acre, depending on stocking rates (range $5/fish to $20/fish, depending on delivery method and quantity purchased).

Appropriateness to Black Lake

Grass carp are known to preferentially feed on southern naiad (*Najas guadalupensis*) (Stewart and Boyd 1999), a close relative of the water nymph which is present in Black Lake. The use of grass carp is unlikely a viable control method for Black Lake because a diverse native plant community is needed to provide suitable aquatic habitat and prevent resuspension of nutrients that could prompt unwanted algae blooms. In addition, outlet control would be needed on both the Black Lake ditch and Black River which could result in potential flooding issues. Permitting may also be problematic due to Black Lake proximity to ESA fisheries bearing waters.

Watermilfoil Weevil

The milfoil weevil, *Euhrychiopsis lecontei*, is a small, herbivorous aquatic beetle, belonging to the family Curculionidae. It is native to the northern U.S., including Washington, and feeds exclusively on aquatic plants in the genus *Myriophyllum*. It is often associated with the native milfoil (*M. sibiricum*), however research indicates that in the presence of both the native and non-native (*M. spicatum*) milfoil, the weevil prefers feeding on the non-native, explaining the interest in using it as a biological control agent. The milfoil weevil is native to Washington lakes and rivers, more often in eastern Washington lakes and more alkaline waters; however, it is also present in cooler, wetter western Washington. It is found associated with both native northern milfoil and milfoil.

Research on the weevil has been conducted in Illinois, Minnesota, Vermont, Washington and Wisconsin as a potential biological control for milfoil. In 1989, state biologists in Vermont reported that milfoil in Brownington Pond had declined from approximately 10 hectares (in 1986) to less than 0.5 hectares. Studies in Minnesota, Vermont, Ohio and Wisconsin suggest that at least 1.5 to 2 weevils per stem is needed to control milfoil (Newman and Biesboer 2000).

Advantages

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

Disadvantages

To date, there have not been any documented declines of milfoil in Washington State that can be attributed to the milfoil weevil. Researchers in Minnesota have suggested that sunfish predation may be limiting weevil densities in some lakes (Sutter and Newman 1997). The same may be true for Washington State as sunfish populations are present in many lakes, including those with weevils. In addition, other environmental factors that may be keeping weevil populations in check in Washington, but have yet to be studied, include over-wintering survival and habitat quality and quantity (Jester et. al. 1997; Tamayo and Grue 2004). Although the milfoil weevil shows potential as a biological control for milfoil, more work is needed to determine which factors limit weevil densities and what lakes are suitable candidates for weevil treatments in order to implement a cost- and control-effective program.

Permits

Again, the milfoil weevil is native to Washington lakes and rivers, but they are also commercially available. Importation of weevils into Washington may require a permit from the Washington Department of Agriculture (WDFA) and/or the U.S. Department of Agriculture (USDA). Contact WDFA for current permitting requirements. As of December 2009 no permits have been issued for Washington.

Costs

The costs for researchers to locate, culture, and test biological control agents are high. Once approved for use, insects can sell for $1.00 or more per insect. Private sources of weevils are available.

Appropriateness to Black Lake

The use of milfoil weevils is unlikely a viable control method for Black Lake due to permitting issues for importing weevils out-of-state from commercial suppliers and because their use will not meet the eradication goal. More significantly, hand-pulling efforts have been so effective there is unlikely sufficient vegetation for the larvae to complete its life cycle. Additionally, there is not suitable overwintering habitat for the weevils (e.g. leave litter along the shoreline) such that stocking would have to occur yearly which could result in substantial costs.

Manual Control Methods

Hand-Pulling

Hand-pulling and removal of rooted, submerged plants involves digging out the entire plant (stem and roots) with a spade of long knife and disposing residue on shore. In shallow waters less than 3 feet, no specialized gear is required. In deeper waters, hand removal can best be accomplished by divers using SCUBA equipment and Sea Sprints or similar devices to increase mobility.

Control Effectiveness and Duration

Efficacy of plant removal depends on sediment type, visibility, and thoroughness in removing the entire plant, particularly the roots or other plant parts capable of spreading and establishing. A high degree of control over more than one season is possible where complete removal has been achieved.

Advantages

Hand-pulling results in immediate clearing of the water column of nuisance plants. The technique is very selective in that individual plants are removed. It is most useful in sensitive areas where disruption must be kept to a minimum. Because the technique is highly labor-intensive, it is most appropriate for small-area, low plant density treatments. In these cases, hand-pulling is very useful for aggressive control of sparse or small pockets of aquatic plants. This method can also be useful for clearing aquatic plants from areas around docks and beaches.

Disadvantages

Hand-pulling is time-consuming and can be costly especially where contract divers are used. Diver visibility may become obscured by turbidity generated by swimming and digging activities. Also, it may be difficult to see and dig out all plant roots. Environmental impacts are limited to mostly short-term and localized turbidity increases in the overlying water and some bottom disruption.

Permits

Hand-pulling requires Hydraulic Project Approval (HPA) by WDFW for limited control of nuisance aquatic vegetation. A copy of the pamphlet may be found online at:
http://wdfw.wa.gov/licensing/aquatic_plant_removal/

Costs

Costs will vary depending on whether contract divers or volunteers are used. In the case of contract divers and dive tenders, expenses can run upward of $1,600 to $3,800/day with the area covered dependent on height and density of plants.

Appropriateness to Black Lake

Hand-pulling is an appropriate method of removing milfoil from Black Lake – provided all fragments are removed from the lake and allowed to dry away from the shoreline. Hand-pulling could be effective for controlling fragrant waterlily, however, removing the dense rhizome on mature plants could be more troublesome than other mechanical methods. Hand-pulling can also be effective for controlling yellow iris; however, the sap is poisonous and can cause skin irritation such that hand protection should be worn when handling all parts of the yellow iris.

Hand-Cutting

This technique is also a manual method, but differs from hand-pulling in that plants are cut below the water surface (roots generally not removed). Because roots are not removed, this is a less intensive removal technique. Implements used include scythes, rakes, or other specialized devices that can be pulled through the weed beds from shoreline or dock or by boat. Mechanized weed cutters are also available that can be operated from the surface for small-scale control.

Control Effectiveness and Duration

Root systems and lower stems are often left intact. As a result, effectiveness is usually short-term as regrowth is possible from the uncut root masses or stems. Duration of control is limited to the time it takes the plant to grow to the surface

Advantages

The technique results in immediate removal of nuisance submerged plant growth. Costs can be minimal, particularly if volunteers are used.

Disadvantages

Like hand-pulling, the technique is time-consuming. Visibility may become obscured by turbidity generated by cutting activities. Also, since the entire plant is usually not removed, this technique does not result in long-term reductions in growth. Environmental impacts are limited to mostly short-term and localized turbidity increases in the overlying water and some bottom disruption. Cut plants must be removed from the water.

Permits

Hand-cutting requires Hydraulic Project Approval (HPA) by WDFW for limited control of nuisance aquatic vegetation. WDFW has created a pamphlet titled "Aquatic Plants and Fish" that primarily addresses problems associated with aquatic noxious weeds. The pamphlet serves as the HPA to expedite removal of early infestations, particularly for small-scale projects that control early infestations and the control of beneficial plants. Removal of some beneficial plants is allowed for clearing areas around docks, and for swimming, however WDFW generally discourages their removal due to their important ecological functions. A copy of the pamphlet may be found online at: http://wdfw.wa.gov/licensing/aquatic_plant_removal/.

Costs

Where volunteer efforts are employed, costs are mostly limited to purchase of a cutting implement. This can vary from under $200 for the Aqua Wee Cutter (Sunrise Corp.) to over $1000 for the mechanized Swordfish (Redwing Products).

Appropriateness to Black Lake

Hand-cutting is an appropriate method of removing milfoil, fragrant waterlily, and yellow iris from Black Lake – provided all fragments are removed from the lake and allowed to dry away from the shoreline.

Raking

Raking is an effective aquatic plant removal technique that tears plants from the sediment, breaking some plants off and removing some roots as well. Attaching a rope to the rake allows a greater reach of plant removal in the waterbody. The rake should be pulled toward the shore to collect and dispose of plants, as weed fragments left in the waterbody can easily spread to other areas and establish or decompose and release nutrients to the lake.

Advantages

The technique results in immediate removal of nuisance submerged plant growth. Costs can be minimal.

Disadvantages

Similar to other manual plant removal methods, the raking method is time consuming and labor intensive. Another disadvantage of this method is that as the cleared plants regrow this method may have to be implemented several times throughout the summer.

Permits

Raking requires Hydraulic Project Approval (HPA) by WDFW for limited control of nuisance aquatic vegetation. WDFW has created a pamphlet titled "Aquatic Plants and Fish" that primarily addresses problems associated with aquatic noxious weeds. The pamphlet serves as the HPA to expedite removal of early infestations, particularly for small-scale projects that control early infestations and the control of beneficial plants. Removal of some beneficial plants is allowed for clearing areas around docks, and for swimming, however WDFW

generally discourages their removal due to their important ecological functions. A copy of the pamphlet may be found online at: http://wdfw.wa.gov/licensing/aquatic_plant_removal/.

Costs

A commercial rake costs about $95 to $125 and a homemade weed rake costs about $85 (asphalt rake is about $75 and the rope costs 35-75 cents per foot).

Appropriateness to Black Lake

Raking is an appropriate method of removing milfoil from Black Lake – provided all fragments are removed from the lake and allowed to dry away from the shoreline. Raking could be effective for controlling fragrant waterlily, however, removing the dense rhizome on mature plants could be more troublesome than other mechanical methods. Raking can also be effective for controlling yellow iris; however, the sap is poisonous and can cause skin irritation such that hand protection should be worn when handling all parts of the yellow iris.

Bottom Barrier Application

Barrier material is applied over the lake bottom to prevent plants from growing up through the water column. Bottom covering materials such as sand-gravel, polyethylene, polypropylene, synthetic rubber, burlap, fiberglass screens, woven polyester, or nylon film have all been used with varying degrees of success. Applications can be made up to any depth, with divers often utilized for deeper water treatments. Usually bottom conditions (presence of rocks or debris) do not impede most barrier applications, although pre-treatment clearing of the site is often useful.

Control Effectiveness and Duration

Bottom barriers can provide immediate removal of nuisance plant conditions upon placement. Duration of control is dependent on a variety of factors, including type of material used, application techniques, and sediment composition. Elimination of nuisance plant conditions for at least the season of application has been demonstrated by burlap and synthetic materials like Aquascreen and Texel. Where short-term control is desired for the least expense, burlap has been found to provide up to four years of relief from problematic growth before eventually decomposing. After satisfactory control has been achieved (usually several months), some barrier materials can be relocated to other areas to increase benefits, however, relocating barriers too soon results in plant bed recovery within a year.

Advantages

Bottom barriers can usually be easily applied to small, confined areas such as around docks, moorages or beaches. They can be hidden from view and do not interfere with shoreline use. Bottom barriers do not result in significant production of plant fragments (critical for milfoil treatment). Bottom barriers are most appropriately used for localized, small-scale control where exclusion of all plants is desirable; where other control technologies cannot be used; and where intensive control is required regardless of cost.

Disadvantages

Depending on the material, substantial drawbacks to the application of bottom barriers include some or all of the following: high materials cost, labor-intensive installation, limited material durability, possible suspension due to water movements or gas accumulation beneath covers, or regrowth of plants from above or below the material. Periodic maintenance of bottom barrier materials is required to remove accumulations of silt and any rooting fragments. In some situations, removal and relocation of barriers may not be possible (e.g. natural fiber burlap decomposes over time). Sediment covers can also produce localized depression in populations of bottom-dwelling organisms like aquatic insects.

Permits

Placement of bottom barriers requires Hydraulic Project Approval (HPA) by WDFW for limited control of nuisance aquatic vegetation. WDFW has created a pamphlet titled "Aquatic Plants and Fish" that primarily addresses problems associated with aquatic noxious weeds. The pamphlet serves as the HPA to expedite removal of early infestations, particularly for small-scale projects that control early infestations and the control of beneficial plants. Removal of some beneficial plants is allowed for clearing areas around docks, and for swimming, however WDFW generally discourages their removal due to their important ecological functions. A copy of the pamphlet may be found online at: http://wdfw.wa.gov/licensing/aquatic_plant_removal/.

Costs

Barrier materials cost $0.22 to $1.25 per square foot. The cost of some commercial barriers includes an installation fee. Commercial installation costs vary depending on sediment characteristics and type of bottom screen selected. It costs up to about $1,250 to have 1,000 square feet of bottom screen installed. Maintenance costs for a waterfront lot are about $120 each year.

Appropriateness to Black Lake

Bottom barriers are an appropriate method of removing plants from small targeted areas and especially for milfoil, water nymph and fragrant waterlily from Black Lake and a strategy that homeowners can easily implement.

Mechanical Control Methods

Mechanical Harvesting

Mechanical harvesting involves large machines that cut and collect aquatic plants by a conveyer belt system for plant disposal. Harvesting occurs in late spring, summer, and early fall when plants are close to the water's surface. This machinery can remove several acres of plants per day and the typical speeds range from 0.5 to 1.5 acres per hour. Due to the large size and high cost of the harvester this type of aquatic plant removal system is ideal for lakes larger than a few acres. Conventional single-stage harvesters combine cutting, collecting, storing and transporting cut vegetation into one piece of machinery. Cutting machines are also available which perform only the cutting function. Maximum cutting depths for harvesters and cutting machines range from 5 to 8.2 ft. with a swath width of 6.5 to 12.1 ft. Cooke et al. (1993) summarizes aquatic plant cutters and harvesters available in North America.

Advantages

Since harvesting involves physical removal and disposal of vegetation from the water, the immediate effectiveness in creating open water areas is quite apparent. Harvesting immediately clears aquatic plants and creates open areas of water for boating and fishing access. Harvesting also has the added benefit that removal of in-lake plant biomass also eliminates a possible source of nutrients often released during fall dieback and decay. This is important in those waterbodies with extensive plant beds and low nutrient inputs from outside sources. Furthermore, harvesting can reduce sediment accumulation by removing plant organic matter that would typically decay and add to the bottom sediments. Depending on species content, harvested vegetation can be easily composted and used as a soil amendment. Mechanical harvesting costs can be relatively low compared to other physical/mechanical techniques.

Disadvantages

Mechanical harvesting is essentially a mowing operation that removes only the upper stem material, and duration of control is variable. Factors such as target plant type, frequency and timing of harvest, water depth, and depth of cut can influence duration of control. Harvesting has not proven to be an effective means of sustaining long-term reductions in growth of milfoil. Regrowth of milfoil to pre-harvest levels typically occurs within 30 to 60 days (Perkins and Sytsma 1987), depending on water depth and the depth of cut. Significant disadvantages of harvesting are the high cost for the equipment as well as the cost to operate and maintain the harvester.

Harvesting needs to occur several times during the growing season and plant fragments left behind by the harvester may increase the spread of invasive species in the lake.

Harvesters should be used in large lakes greater than a few acres and are not suitable for smaller or very shallow lakes (e.g., 3 to 5 feet of water) or those with manmade surface obstructions or tree stumps. There is usually little interference with use of waterbody during harvesting operations. Cut plant material requires collection and removal from the water. Harvesting creates plant fragments and since milfoil can rapidly disperse and regrow by stem breakage, harvesting would not be an appropriate large-scale technique or where eradication is the goal. Harvesting can be detrimental to non-target plants and animals (e.g. fish, invertebrates) associated with plant beds, which are removed indiscriminately by the process. Harvesting can lead to enhancement of growth of opportunistic plant species that may invade treated areas.

Permits

Mechanical harvesting requires Hydraulic Project Approval (HPA) by WDFW for limited control of nuisance aquatic vegetation. WDFW has created a pamphlet titled "Aquatic Plants and Fish" that primarily addresses problems associated with aquatic noxious weeds. The pamphlet serves as the HPA to expedite removal of early infestations, particularly for small-scale projects that control early infestations and the control of beneficial plants. Removal of some beneficial plants is allowed for clearing areas around docks, and for swimming, however WDFW generally discourages their removal due to their important ecological functions. A copy of the pamphlet may be found online at: http://wdfw.wa.gov/licensing/aquatic_plant_removal/.

Because harvesting collects fish along with aquatic plants, some additional monitoring may be required when harvesting in salmon bearing waters, or a permit may be denied.

Costs

Harvesting program costs depend on factors such as scale, composition and density of vegetation, equipment used, skill of personnel, and site-specific constraints (e.g. large obstacles). Detailed costs are not uniformly reported, so comparing projects costs of one program with another can be difficult. Costs as low as $250 per acre have been reported. Private contractors generally charge $500 to $800 per acre. The purchase price of harvesters ranges from $35,000 to $160,000. There are several harvester manufacturers in the United States and some lake groups may choose to operate and purchase their own machinery rather than contracting for these services.

Appropriateness to Black Lake

Because eradication of non-native aquatic plants is the objective at Black Lake, further use of mechanical harvesting is not considered an appropriate control method.

Driver-Assisted Suction

Diver-assisted suction (also known as diver-dredging) involves the use of hoses that are attached to small dredges to suck up plant material which are pumped to the water surface for disposal. The suction dredging removes all parts of the plant including the roots. This method will remove approximately one quarter to one acre per day depending on the plant density, sediment type and the efficiency of the diver.

Control Effectiveness and Duration

An exemplary diver suction dredging of milfoil in Western Washington's Silver Lake removed 80 percent of the plant population over two years. Diver dredging is an effective control method for species such as milfoil but less effective for plants where seeds, turions, or tubers remain in the sediments to sprout in the next growing season.

Advantages

Diver-assisted suction is an effective aquatic plant removal method around docks and other difficult areas to reach by large equipment and is safe for the environment.

Disadvantages

Diver-assisted suction is labor intensive and therefore can be expensive. This method also stirs up sediment, which can lead to the release of nutrients or toxins in the sediment to enter the water column.

Permits

Diver-assisted suction requires Hydraulic Project Approval (HPA) by WDFW for limited control of nuisance aquatic vegetation. WDFW has created a pamphlet titled "Aquatic Plants and Fish" that primarily addresses problems associated with aquatic noxious weeds. The pamphlet serves as the HPA to expedite removal of early infestations, particularly for small-scale projects that control early infestations and the control of beneficial plants. Removal of some beneficial plants is allowed for clearing areas around docks, and for swimming, however WDFW generally discourages their removal due to their important ecological functions. A copy of the pamphlet may be found online at: http://wdfw.wa.gov/licensing/aquatic_plant_removal/.

Costs

Depending on the density of the plants, specific equipment used, and disposal requirements, costs can range from a minimum of $1,500 to $3,800 per day.

Appropriateness to Black Lake

Diver-assisted suction is an appropriate method of removing non-native aquatic plants from Black Lake and one that is recommended for control efforts in Black Lake.

Hydraulic (Suction) Dredging

Hydraulic dredging involves removal of littoral sediments and associated rooted aquatic plants using hydraulic dredging equipment. Lake sediment removal is most often performed by means of a cutter-head hydraulic pipeline dredge (Cooke et. al. 1993). In terms of operation, plants/sediment loosened by the cutter head travels to the pickup head. The slurry is then suctioned up and carried back to the dredge barge through hoses. The sediment slurry is then piped off-site for disposal.

Control Effectiveness and Duration

Large-scale sediment removal techniques can often provide multiple benefits to an aquatic system (Cooke et. al. 1993). Depending on the waterbody, possible enhancements include not only rooted macrophyte control, but also increased depth, and removal of nutrients or toxic substances. Efficiency of removal is dependent on equipment, sediment type and condition, with conventional dredges performing well on harder sediment. Various types of portable hydraulic dredges are available in the U.S. that are more effective for small lakes with softer, flocculent substrate. Longevity of control is dependent on a number of factors including sedimentation rate (the lower the better), watershed-to-surface-area ratios (nominally 10:1), and hydraulic residence time (the longer the better).

Advantages

Dredging removes entire plants, including root systems, so regrowth is minimized. Plant fragments are collected and retained, and spread is minimized (very important for control of milfoil and other species that spread by fragments). It can be used to cover areas larger than practical for diver-operated dredging or diver hand removal, or where herbicides cannot be used. Human health and safety concerns are negligible where operations are conducted prudently.

Disadvantages

Hydraulic dredging is very expensive and highly disruptive to the local environment. A major problem often involves finding suitable offsite disposal areas and transporting dredged materials to these sites. As a result, more specialized equipment and materials are required and the process can be much more costly. Short-term environmental effects include resuspension of sediments and localized turbidity increases in the area of treatment. Release of nutrients and other contaminants from enriched sediments can also be a problem. In addition, some non-target aquatic organisms and vegetation may be inadvertently removed during the process. However, if only a portion of the lake bed is dredged, impacts on benthic aquatic life should be short-lived (Cooke et. al. 1993).

Permits

Use of suction dredging requires Hydraulic Project Approval (HPA) by WDFW for limited control of nuisance aquatic vegetation. WDFW has created a pamphlet titled "Aquatic Plants and Fish" that primarily addresses problems associated with aquatic noxious weeds. The pamphlet serves as the HPA to expedite removal of early infestations, particularly for small-scale projects that control early infestations and the control of beneficial plants. Removal of some beneficial plants is allowed for clearing areas around docks, and for swimming, however WDFW generally discourages their removal due to their important ecological functions. A copy of the pamphlet may be found online at: http://wdfw.wa.gov/licensing/aquatic_plant_removal/. Suction dredging may also require a local shoreline management permit. It will also be necessary to obtain a letter of approval from the Washington State Department of Natural Resources, a Section 404 permit from the U.S. Army Corps of Engineers, and a National Pollutant Discharge Elimination System (NPDES) permit from Ecology.

Costs

Dredging costs are highly variable, depending on density and volume of sediment removed, equipment condition, transport requirements of dredged material, and eventual use of dredged material (Cook et. al. 1993). Hydraulic dredging costs historically range from a minimum of $2.25 per cubic meter to $15 per cubic meter, although figures as high as $20 to $50 per cubic meter have been reported and with disposal and permitting costs dredging costs are increasing much faster than inflation rates.

Appropriateness to Black Lake

Hydraulic dredging is not currently considered an appropriate method of removing nuisance aquatic vegetation from Black Lake due to the limited size of remaining milfoil beds, expense, and arduous permitting process.

Rotovation

Rotovation involves highly specialized large aquatic rototillers which uproot entire plants from the sediment. The rotovation blades reach seven to nine inches deep into the lake bottom and uproot plants and roots which are removed by weed raking or by a mechanical harvester.

Control Effectiveness and Duration

Rotovation can be used year-round as a mechanical control in certain waterbodies, but is most effective in winter and early spring when the plants have died back. Rotovation can remove two to three acres of plant material per day and studies have shown effective control up to two growing seasons after a rotovation.

Advantages

This mechanical control method effectively removes the entire plant and treatments decrease/control plant density for two growing seasons. Rotovation can also be used year-round in certain waterbodies if the permit allows and rotovation can stimulate the growth of native aquatic plants.

Disadvantages

Disadvantages of this mechanical control method include: difficulty to maneuver, high cost for maintenance and operation, labor intensive effort and it may actually increase the spread of invasive weeds (e.g. those that spread by fragments). Underwater utilities, such as gas, water, sewer, telephone or water intake pipes, need to be located before rotovation begins.

Permits

Rotovation requires HPA by WDFW, a shoreline permit from the local jurisdiction (city/county) may be needed, and a Section 404 permit from the Army Corp of Engineers may be required.

Costs

Costs for a private contractor to harvest plants, remove obstacles, rotovate, and collect and dispose of plants range from $1,500 to $2,000 per acre. As plant density decreases and obstacles are removed, costs and time needed to rotovate each acre will decrease.

Appropriateness to Black Lake

Rotovation is not considered an appropriate method of controlling nuisance aquatic vegetation in Black Lake, largely due to expense.

Chemical Control Methods

Chemical control of invasive aquatic plants involves the application of products specifically formulated for applications in or around water. In addition to approval by the U.S. Environmental Protection Agency (EPA) and Ecology, Thurston County's Public Health and Social Services has reviewed several aquatic herbicides and developed an approved list of products acceptable for application as part of County projects.

Aquatic herbicides are sprayed directly onto floating or emergent aquatic plants or are applied to the water in either a liquid or granular form to control submersed plants. Systemic herbicides are capable of killing the entire plant. Contact herbicides cause the parts of the plant in contact with the herbicide to die back, leaving the roots alive and able to regrow. Non-selective, broad spectrum herbicides will generally affect all plants that they come in contact with. Selective herbicides will affect only some plants (often dicots - broad leafed plants like milfoil will be affected by selective herbicides whereas monocots like Brazilian elodea (*Egeria densa*) may not be affected). Most aquatic plants are monocots.

Approved Herbicides

Table 4 lists some of the aquatic herbicides approved by the U.S. EPA, Ecology, and Thurston County for use in controlling milfoil, yellow iris, fragrant waterlily, and water nymph in Washington. Also included are the trade names under which these products are sold, its mode of action (e.g. systemic or contact), information about its selectivity, some management uses and considerations, and water use restrictions. See Appendix B to view the herbicide specimen labels. Table 5 lists the basic permitting requirements for herbicides and other control techniques.

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Table 4. Aquatic Herbicides Approved for Use in Thurston County, Washington

Active Ingredient (S) = systemic (C) = contact	Trade Names (G) = granular (L) = liquid	Target species in Black Lake	Selectivity	Management Uses and Considerations	Label Water Use Restrictions and Advisories (Ecology)			
					Drinking	Swimming	Fish	Irrigation***
Fluridone (C)	Sonar AS (L) Avast! SC (L) Sonar PR (G) Sonar SRP (G) Sonar Q (G)	Milfoil Water nymph	Non-selective; slow acting	Appropriate for areas of low water exchange; used for whole-lake treatment or in isolated bays; not appropriate for spot treatment < 5 acres				30 days
Glyphosate (S)	Rodeo (L) AquaMaster (L) AquaPro (L)	Fragrant waterlily Yellow iris	Non-selective; slow acting	Glyphosate only controls plants that are above water; apply directly to plant or as hollow stem injection (AquaMaster only); treat in strips to avoid oxygen depletion from decaying vegetation	No application within ½ mile of active potable water intake; see label for details	No restriction on the use of treated water for recreation or domestic purposes		No restriction on the use of treated water for irrigation purposes
Imazamox (S)	Clearcast (L)	Milfoil Fragrant waterlily		Requires use of an adjuvant	May be applied up to 500 ppb to within ¼ mile of active potable water intake			Not for irrigation until residues < 50 ppb; see label for details
Triclopyr (triethylamine [TEA] salt)* (S)	Renovate 3 (L) Renovate OTF (G)	Milfoil Fragrant waterlily	Selective for broad-leaved plants; fast acting	Appropriate for spot and whole-lake treatments		Advisory (Ecology) during and 12 hr post-treatment		Not for irrigation for 120 days or until <1.0 ppb; see label for details
Conditional Use Products in Thurston County[1]								
Endothall (dipotassium salt) (C)	Aquathol® K (L) Aquathol® Super K (G)	Milfoil Water nymph	Selective contact; fast-acting	Short-term control; appropriate for spot treatment	7 to 25 days	Advisory (Ecology) during and 24 hr post-treatment	3 days	14 days
Imazapyr (S)	Ecomazapyr (L) Gullwing (L) Habitat (L) Polaris (L)	Fragrant waterlily Yellow iris	Non-selective systemic	Not for use on submersed plants; requires use of a surfactant	No application within ½ mile of active potable water intake; see label for details	There are no swimming restrictions	There are no fishing restrictions	Treated water may not be used for 120 days or until <1.0 ppb; see label for details

[1]Thurston County (2011b)
* Ground water monitoring protocols shall be used if a Permittee is applying triclopyr for the third time in a three year period (Appendix D).
** Ranges in days determined by application rate, see label for details.
*** See labels for more specific irrigation restrictions.

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Advantages

Aquatic herbicides are easily applied around docks and underwater obstructions. Aquatic herbicide application can be less expensive than other aquatic plant control methods, especially when used in controlling wide-spread infestations of state-listed noxious aquatic weeds.

Disadvantages

- Some herbicides have swimming, drinking, fishing, irrigation, and water use restrictions (check the label and the Ecology permit [discussed below]).
- Herbicide use may have unwanted impacts to people who use the water and to the environment.
- Non-targeted plants as well as nuisance plants may be controlled or killed by some herbicides.
- Depending on the herbicide used, it may take several days to weeks or several treatments during a growing season before the herbicide controls or kills treated plants.
- Rapid-acting herbicides like endothall may cause low oxygen conditions to develop as plants decompose. Low oxygen can cause fish kills.
- To be most effective, generally herbicides must be applied to rapidly-growing plants, although sometimes fall applications of perennial plants can also be effective.
- Expertise in using herbicides is necessary in order to be successful and to avoid unwanted impacts.
- Public perception to the application of chemicals to water can be unfavorable.

Permits

Because of environmental risks from improper application, an aquatic herbicide application in Washington state waters is regulated and has the following restrictions:

- Applicators must be licensed by the Washington State Department of Agriculture.
- Applicants must obtain coverage under a National Pollutant Elimination Discharge (NPDES) permit before they can legally apply aquatic herbicides to waters of the state.
- Ecology requires notification and posting before treatment and, if applicable, there are additional mitigations to protect rare plants or threatened and endangered species.

Ecology issued a "lake" NPDES general permit March 1, 2006 to cover the management of in-lake noxious weeds and native aquatic plants and algae. For in-lake projects applicators and/or the state or local government sponsoring the project must obtain coverage under Ecology's Aquatic Plant and Algae Management General Permit[1] before applying herbicides. The process for obtaining NPDES coverage and follow-up actions includes:

1. Submit a Notice of Intent application form to Ecology requesting coverage under this permit at least 60 days prior to the planned activity resulting in the discharge to waters of the state. The application shall contain a copy of the public notice and the expected date of the second publication
2. Complete a State Environmental Policy Act (SEPA) Checklist and submit to Ecology
3. Adhere to all Ecology Requirements (Appendix D - F) as identified in the Permit, including:

[1] To view the Permit: http://www.ecy.wa.gov/programs/wq/pesticides/permit_documents/APAMfinalpermitrevised011509.pdf

a. Ecology Notification
b. Residential and Business Notification
c. Camp Notification (not applicable to Black Lake)
d. Posting Requirements (templates provided in Appendix G)

Costs

These costs are estimates and will vary from site to site depending on treatment rates, water depths, amount of notification needed, difficulty of access to the site, and other factors. Approximate costs for one acre herbicide treatment: Fluridone: $1,800 to $2,800, Glyphosate: $250-600,Imazamox: $800 to $1,400, Triclopyr: $1,800-$2,800, Endothall: $500-$800, Imazapyr: $800-$1,400.

Appropriateness to Black Lake

The application of aquatic herbicides, in combination with other aquatic plant control methods, substantially increases the likelihood of eradicating non-native aquatic plants from Black Lake. Where eradication is the goal, the application of aquatic herbicides is the most aggressive method to rapidly reduce vegetation coverage and allow for other methods such as benthic barriers and diver-assisted hand pulling.

Table 5. Permitting Requirements for Aquatic Weed Control Activities in Washington

Permit/document	Agency	Description	Control Activities	Minimum Process Time
State Environmental Policy Act (SEPA)	Local or state agency	Requires complete disclosure of proposed actions; SEPA checklist required for herbicide use and grass carp stocking	Herbicides, grass carp stocking	60 days
Aquatic Plant and Algae Management General Permit: National Pollutant Discharge Elimination System (NPDES)	Ecology	Covers aquatic plant and algae management activities that discharge chemicals and other aquatic plant and algae control products into surface waters of the state of Washington	Herbicides, algaecides, adjuvants, marker dyes, barley straw, shading projects, biological water clarifiers, and nutrient inactivation products	60 days
State Shoreline Management Act	Ecology and local jurisdiction	Permit ensures that proposed activity complies with the local Shoreline Master Program. Includes lakes 20-acres or more, and can include associated wetland and some floodplains	Bottom barriers (based on area/cost), rotovation, harvesting, diver dredging	75 days
Hydraulic Project Approval (HPA - State Hydraulic Code)	Fish and Wildlife	HPA required for work below the ordinary high water line	All aquatic plant control activities need an HPA, but many activities are permitted by obtaining publication #APF-1-98 - Aquatic Plants and Fish	45 days
Natural Heritage Program Letter (confirming search of date for critical plant species)	Department of Natural Resources	Natural Heritage Program is the state repository of data on endangered, threatened and sensitive species, native wetland communities, aquatic and nonvegetated wetlands	Search should be conducted for any control activity	3-7 days
Fish Planting Permit	Fish and Wildlife	A permit is required for stocking of triploid (sterile) grass carp in Washington waters for control of aquatic vegetation	Grass carp stocking	45 days
Local Permits	Local jurisdictions	Permits may be required on the local level for various activities. Permits may include Shoreline Management, Growth Management Act/Sensitive Area Ordinance	Variable	Variable

Source: Gibbons et al. 1994

BLACK LAKE INTEGRATED TREATMENT ALTERNATIVES

The aquatic plant management objectives for Black Lake are to eradicate non-native milfoil, fragrant waterlily, and yellow iris while simultaneously providing for the balanced management of native plants and maximizing beneficial uses. Eradication implies the complete and permanent elimination of all viable plant propagules (reproductive structures, including stem fragments, tubers, and seeds) (Gettys et al. 2009). Eradication will require a multi-year, aggressive, and dedicated effort using multiple tools and frequent surveys. In addition, prevention efforts will be necessary to ensure new populations of milfoil (or other invasive plant or animal species) are not introduced and established.

The approach to eradicating a specific aquatic plant species depends on numerous factors including plant distribution and density, Specimen Label restrictions for aquatic herbicides (Appendix A), existing beneficial uses, public perception, and available funding.

Four management alternatives were discussed at Save Black Lake Coalition public meetings. A summary of each alternative and its respective approach are summarized below and in Tables 6 to 8.

Alternative 1: No Action

The No Action Alternative acknowledges the presence of nuisance native and non-native aquatic plants but not does call for any control or even planning activities.

Advantages

There are few advantages to "doing nothing" to control or prevent the further spread of invasive aquatic plants; however, there may be a perception of saving money by not investing in activities such as mechanical harvesting, hand-pulling, herbicide application, or even boat washing stations.

Disadvantages

The No Action Alternative can result in long-term deleterious effects on the ecology, recreational uses and aesthetics of a lake. Invasive aquatic plants disrupt dissolved oxygen patterns, displace native plant species, and impair navigation. While changes to water quality may be less obvious to the casual observer, their seasonal and long-term impacts can seriously threaten features that attract homeowners, outdoor enthusiasts, anglers, and boaters to a waterbody.

Appropriateness to Black Lake

The current distribution of milfoil, fragrant waterlily, and yellow iris at Black Lake is already at nuisance levels and will likely only increase if a concentrated effort to control the infestations is not implemented. Based on the goal of eradication and the objectives of the Save Black Lake Coalition, the No Action Alternative is not appropriate for Black Lake.

Alternative 2: Manual Control

The second alternative builds on recent control measures implemented at Black Lake. That is, the use of hand-pulling to control milfoil will be augmented with other manual methods including cutting devices, benthic barriers, and diver-assisted suction to also control yellow iris and fragrant waterlily (Table 6). To control yellow iris, underwater cutting devices may be used to remove mature stems; however, this will not reduce the spread of yellow iris by rhizomes. Removal of mature seed heads is essential to preventing further spread. Precautions to protect exposed skin should be taken when in contact with yellow iris. Similarly, to control fragrant waterlily the use of cutting devices, hand-pulling, and bottom barriers are effective. Ecology (2011b) reports frequent harvesting of emerging fragrant waterlily leaves during the growing season as an effective means of control. Milfoil control will continue through extensive surveying and diver hand-pulling.

As part of Alternative 2, prevention efforts such as signage at the boat launches to encourage boat washing will be increased compared to current efforts. Currently invasive aquatic plant prevention signage only exists at the WDFW boat launch.

Advantages

Alternative 2 provides opportunities for resident involvement and includes control measures that are generally perceived as more favorable by the public. Increased prevention measures will also reduce the risk of invasion by other non-native organisms such as zebra mussels, New Zealand mudsnails, or other nuisance aquatic vegetation.

Disadvantages

Manual control measures are very labor intensive, particularly during the initial phases of management when infestations are at their peak. These measures also increase the likelihood of plant fragments spreading to other areas of the lake if extreme care is not taken to remove them.

Appropriateness to Black Lake

Alternative 2 is an appropriate, albeit less aggressive, approach to reducing populations of milfoil, yellow iris, and fragrant waterlily in Black Lake. This approach requires a long-term commitment which will likely be expensive and may not reach the eradication goal in a timely enough manner to meet resident's expectations. Table 6 summarizes a four year plan for managing these nuisance species using manual and mechanical control methods.

Table 6. Summary of Alternative 2: Manual Control Approach

Year	Action	
1	**Summer**	Map existing populations of milfoil, iris, fragrant waterlily and native aquatic plants; manually control satellite populations of non-native species with diver-assisted suction and hand-pulling; install benthic barriers around target areas (boat docks, piers, swimming areas)
	Fall	Survey to inform Year 2 management; manually control satellite populations with diver-assisted suction and hand-pulling; install benthic barriers around target areas (boat docks, piers, swimming areas); implement prevention measures at all public and private recreation access points
2	**Summer**	Map existing populations of milfoil, iris, fragrant waterlily and native aquatic plants; manually control satellite populations of non-native species with diver-assisted suction and hand-pulling; relocate benthic barriers
	Fall	Survey to inform Year 3 management; manually control satellite populations with diver-assisted suction and hand-pulling
3	**Summer**	Map existing populations of milfoil, iris, fragrant waterlily and native aquatic plants; manually control satellite populations of non-native species with diver-assisted suction and hand-pulling; relocate benthic barriers
	Fall	Survey to inform Year 4 management; manually control satellite populations with diver-assisted suction and hand-pulling
4+	**Summer**	Map existing populations of milfoil, iris, fragrant waterlily and native aquatic plants; manually control satellite populations of non-native species with diver-assisted suction and hand-pulling; relocate benthic barriers)
	Fall	Survey to inform future management; manually control satellite populations with diver-assisted suction and hand-pulling

Alternative 3: One year Herbicide + Manual Controls

The third alternative is a more aggressive approach to eradicating milfoil, fragrant waterlily, and iris while reducing nuisance levels of the native water nymph from Black Lake. In particular, Alternative 3 incorporates manual controls identified in Alternative 2 in addition to one year of herbicide application. In year 1, products that target fragrant waterlily, iris, and water nymph would be applied early in the growing season while satellite populations of milfoil would be controlled by manual methods similar to Alternative 1. Low concentrations of fluridone may be applied in the spring to reduce nuisance levels of water nymph. A low dose is recommended to simultaneously reduce nuisance levels while maintaining sufficient aquatic habitat for invertebrates and fishes and to reduce resuspension on sediment and nutrients that could prompt an algae bloom. To control yellow iris, spot applications or stem injections of glyphosate to actively growing stems is recommended. Triclopyr may be used to control fragrant waterlily. Triclopyr is coincidently effective in controlling milfoil such that errant colonies growing in dense fragrant waterlily beds may also be controlled.

Alternative 3 also incorporates manual control methods, largely to target satellite populations of milfoil, but also to be used to control surviving patches of yellow iris and fragrant waterlily. Manual controls would be the primary method of managing milfoil, yellow iris, and fragrant waterlily in subsequent years (Table 7).

Advantages

An emphasis on manual control methods with limited reliance an aquatic herbicide may be more favorable to the Black Lake community. Also, one year of aquatic herbicide use would significantly reduce the biomass of nuisance vegetation, such that manual methods would be less labor intensive and less costly, particularly in year 1. Results of an herbicide application would be much more rapid than solely relying on manual methods.

Disadvantages

Some members of the Black Lake community may not have a favorable view of aquatic herbicides. The expense of an herbicide application would be incurred by the Black Lake community or would rely on grants (e.g. Ecology's Aquatic Weeds Management Fund). The cost of manual harvesting of milfoil is currently covered by Thurston County; however, future availability of these funds has not been confirmed. Cost for this effort has been as much as $25,000 per year.

Appropriateness to Black Lake

Alternative 3 is an appropriate and more aggressive approach to reducing populations of yellow iris, fragrant waterlily, and water nymph in Black Lake. Current populations of milfoil are scattered and, at present, manageable by hand-pulling, thus Alternative 3 only uses manual methods of control for milfoil. Alternative 3 may require a more substantial one-time investment; however, this is expected to be significantly less than the same level of effort to control all four species using manual methods alone. That is, Alternative 3 provides greater control of more species in less time.

Table 7. Summary of Alternative 3: One Year Herbicide + Manual Controls

Year	Action	
1	**Fall/ Winter**	Prepare pesticide general permit for the application of aquatic herbicides approved by Ecology and Thurston County
	Spring/ Summer	Map existing populations of milfoil, iris, fragrant waterlily, and native aquatic plants; apply low concentration of fluridone to reduce (but not eradicate) water nymph, apply glyphosate to control yellow iris, and triclopyr to control fragrant waterlily; hand-pull satellite populations of milfoil
2	**Summer**	Map existing populations of milfoil, iris, fragrant waterlily and native aquatic plants; manually control satellite populations of non-native species with diver-assisted suction and hand-pulling; install benthic barriers around target areas (boat docks, piers, swimming areas)
	Fall	Survey to inform Year 3 management; manually control satellite populations with diver-assisted suction and hand-pulling; install benthic barriers around target areas (boat docks, piers, swimming areas); implement prevention measures at all public and private recreation access points
3	**Summer**	Map existing populations of milfoil, iris, fragrant waterlily and native aquatic plants; manually control satellite populations of non-native species with diver-assisted suction and hand-pulling; relocate benthic barriers around target areas (boat docks, piers, swimming areas)
	Fall	Survey to inform Year 3 management; manually control satellite populations with diver-assisted suction and hand-pulling
4+	**Summer**	Map existing populations of milfoil, iris, fragrant waterlily and native aquatic plants; manually control satellite populations of non-native species with diver-assisted suction and hand-pulling; relocate benthic barriers
	Fall	Survey to inform Year 4+ management; manually control satellite populations with diver-assisted suction and hand-pulling

Alternative 4: Two Year Herbicide + Manual Controls

The fourth alternative is the most aggressive approach to eradicating milfoil, fragrant waterlily, and iris while reducing nuisance levels of the native water nymph from Black Lake. In particular, Alternative 4 incorporates manual controls identified in Alternative 2 in addition to two years of herbicide application. In year 1, products that target fragrant waterlily, iris, and water nymph would be applied early in the growing season while satellite populations of milfoil would be controlled by manual methods similar to Alternative 1. Low concentrations of fluridone may be applied in the spring to reduce nuisance levels of water nymph. As previously mentioned, a low dose is recommended to simultaneously reduce nuisance levels while maintaining sufficient aquatic habitat for invertebrates and fishes and to reduce resuspension on sediment and nutrients that could prompt an algae bloom. To control yellow iris, spot applications or stem injections of glyphosate to actively growing stems is recommended. Triclopyr may be used to control fragrant waterlily. Triclopyr is coincidently effective in controlling milfoil such that errant colonies growing in dense fragrant waterlily beds may also be controlled. Management actions in Year 2 would be determined by spring survey results and would simply provide for the opportunity to apply aquatic herbicides to control yellow iris, fragrant waterlily, and water nymph; however, for single observations, or small (e.g., <2 acres), hand-pulling may still be

preferred. Manual controls would be the primary method of managing milfoil, yellow iris, and fragrant waterlily in subsequent years (Table 8).

Advantages

Alternative 4 provides more options to control nuisance aquatic vegetation in Black Lake. This approach combines existing manual approaches with more aggressive tools in year 1 and year 2. It provides more flexibility to the Save Black Coalition to use more aggressive approaches in year 2. More specifically, the (Aquatic Plant General Permit) submitted to Ecology will explicitly list the products and duration of their use, but it does not require their implementation. Simply stated alternative 4 allows for the implementation of an adaptive management program based on monitoring data and plant community response to previous years treatment efforts.

Disadvantages

Some members of the Black Lake community may not have a favorable view of aquatic herbicides. The expense of an herbicide application would be incurred by the Black Lake community or would rely on grants (e.g. Ecology's Aquatic Weeds Management Fund). It is expected that any herbicide treatments in year 2 would be substantially less than year 1, they would have to be considered in the planning and funding process by Save Black Lake Coalition and Thurston County. The cost of manual harvesting of milfoil is currently covered by Thurston County; however, future availability of these funds has not been confirmed and this is a real cost that has to be planned for.

Appropriateness to Black Lake

Alternative 4 is an appropriate and much more aggressive approach to reducing populations of yellow iris, fragrant waterlily, and water nymph in Black Lake. Current populations of milfoil are scattered and, at present, manageable by hand-pulling, thus Alternative 4 only uses manual methods of control for milfoil. Alternative 4 will require a more substantial investment in product (though less so in year 2); however, this is expected to be significantly less than the same level of effort to control all four species using manual methods alone. That is, Alternative 4 provides even greater control of more species in less time.

Table 8. Summary of Alternative 4: Two Year Herbicide + Manual Controls

Year	Action	
1	**Fall/ Winter**	Prepare pesticide general permit for the application of aquatic herbicides approved by Ecology and Thurston County
	Spring/ Summer	Map existing populations of milfoil, iris, fragrant waterlily, and native aquatic plants; apply low concentration of fluridone to reduce (but not eradicate) water nymph, apply glyphosate to control yellow iris, and triclopyr to control fragrant waterlily; hand-pull satellite populations of milfoil
2	**Summer**	Map existing populations of milfoil, iris, fragrant waterlily, and native aquatic plants; where hand-pulling is not feasible (e.g. >2 acres) apply low concentration of fluridone to reduce (but not eradicate) water nymph, apply glyphosate to control yellow iris, and triclopyr to control fragrant waterlily; hand-pull satellite populations of milfoil
	Fall	Survey to inform Year 3 management; manually control satellite populations with diver-assisted suction and hand-pulling; install benthic barriers around target areas (boat docks, piers, swimming areas); implement prevention measures at all public and private recreation access points
3	**Summer**	Map existing populations of milfoil, iris, fragrant waterlily, and native aquatic plants; where hand-pulling is not feasible (e.g. >2 acres)apply low concentration of fluridone to reduce (but not eradicate) water nymph, apply glyphosate to control yellow iris, and triclopyr to control fragrant waterlily; hand-pull satellite populations of milfoil
	Fall	Survey to inform Year 3 management; manually control satellite populations with diver-assisted suction and hand-pulling
4+	**Summer**	Map existing populations of milfoil, iris, fragrant waterlily and native aquatic plants; manually control satellite populations of non-native species with diver-assisted suction and hand-pulling; relocate benthic barriers
	Fall	Survey to inform Year 4+ management; manually control satellite populations with diver-assisted suction and hand-pulling

Preferred Scenario

Alternative 4 is the preferred scenario for the IAVMP because it offers the best route for meeting the lake management goals in the shortest time period. This will also allow for the attention of the citizens and County to concentrate on non-native species prevention and other water quality management issues to ensure the sustained beneficial uses of the lake. Alternative 4 is the approach favored by the citizens involved in the Save Black Lake Coalition. This is based on consensus at the September 22, 2011 meeting.

Budget

Table 9. Estimated Cost of Developing and Implementing Alternative 4 of the Black Lake IAVMP

	Estimated Cost by Year				
	1	2	3	4	5
IAVMP Development and Reviews	$22,000	$0	$0	$0	$0
Permitting		$6,000	$3,000	$3,000	$1,000
Herbicide Application					
Fluridone targeting water nymph		$9,000	$9,000	$5,000	
Glyphosate targeting yellow iris		$1,000	$600	$300	
Triclopyr targeting fragrant waterlily and milfoil		$59,000	$12,000	$4,000	
Plant Surveys (twice annual)		$10,000	$5,000	$5,000	$5,000
Diver-assisted Hand-pulling		$15,000	$10,000	$8,000	$5,000
Capital Costs (rakes, benthic barriers, etc.)		$3,000	$3,000	$3,000	$3,000
Public Education (signs, presentation, brochures)		$5,000	$2,000	$1,000	$1,000
Estimated Total		**$108,000**	**$45,600**	**$29,300**	**$15,000**

Table 10. Current Estimated Aquatic Plant Coverage in Black Lake

Plant Species	Acreage
Detailed Communities	
Yellow Iris	0.21
Fragrant Waterlily	3.0
Mixed Community Beds	**36.7**
Dominant Plant – Fragrant Waterlily	27.7
Dominant Plant – Spatterdock	4.2
Dominant Plant – Water nymph	4.8

MONITORING, RESPONSE AND PREVENTION

In addition to aggressive control measures, successful eradication of non-native aquatic plant species from Black Lake will also require diligent (preferably twice annual) monitoring for new or expanding populations. Careful removal of targeted species with minimal impacts to non-target species will help to maintain ecosystem function and protect aquatic habitat for desirable species. Responding to new or expanding infestations of milfoil has been a priority for Thurston County and the Save Black Lake Coalition. In an effort to avoid impacts from other nuisance plants, surveys should also include efforts to identify and respond to new non-native aquatic or emergent plant species that could become problematic at Black Lake (Table 11). Specific examples include hydrilla (*Hydrilla verticillata*), once known to occur in Washington but has since been eradicated, and variable-leaf pondweed (*Myriophyllum heterophyllum*) which is increasingly problematic in the Pacific Northwest.

Table 11. Other Non-native Aquatic/Emergent Plant Species to Monitor at Black Lake

Scientific name	Common name	Noxious Weed Listing*
Arundo donax	giant reed	-
Butomus umbellatus	flowering Rush	-
Cabomba caroliniana	fanwort	Class B
Cyperus eragrostis	sedge, lovegrass	-
Egeria densa	Brazilian elodea	Class B
Eichhornia crassipes	water hyacinth	-
Hydrilla verticillata	hydrilla	Class A
Hydrocharis morsus-ranae	frogs-bit, Eurasian	-
Ludwigia hexapetala	water primrose	Class B
Lysimachia vulgaris	loosestrife, garden	Class B; Thurston Co. noxious weed list
Lythrum salicaria	loosestrife, purple	Class B; Thurston Co. noxious weed list
Lythrum virgatum	loosestrife, wand	Class B; Thurston Co. noxious weed list
Myriophyllum heterophyllum	variable-leaf milfoil	Class A; Thurston Co. noxious weed list
Myriophyllum aquaticum	parrot feather	Class B; Thurston Co. noxious weed list
Nymphoides peltata	yellow floating heart	Class B
Phragmites australis	reed, common	Class B; Thurston Co. noxious weed list
Potamogeton crispus	curlyleaf pondweed	Class C
Potentilla argentea	cinquefoil, silvery	Class B
Rorippa nasturtium-aquaticum	watercress	
Typha angustifolia	cattail, lesser	
Utricularia inflata	bladderwort, swollen	

Class A noxious weeds are non-native species whose distribution in Washington is still limited; eradicating existing infestations and preventing new infestations is priority; eradication of all Class A plants is required by law.

Class B noxious weeds are nonnative species whose distribution is limited to portions of Washington State; species are designated for control in state regions (see http://www.nwcb.wa.gov/weed_list/Class_B_weeds.htm).

Class C noxious weeds are either already widespread in Washington or are of special interest to the agricultural industry.

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APPENDIX A HERBICIDE SPECIMEN LABELS

Specimen Label

Sonar* A.S.
Aquatic Herbicide

AN HERBICIDE FOR MANAGEMENT OF AQUATIC VEGETATION IN FRESH WATER PONDS, LAKES, RESERVOIRS, POTABLE WATER SOURCES, DRAINAGE CANALS AND IRRIGATION CANALS.

Active Ingredient

Fluridone: 1-methyl-3-phenyl-5-[3-(trifluoromethyl)phenyl] -4(1*H*)-pyridinone	41.7%
Other Ingredients	58.3%
TOTAL	100.0%

Contains 4 pounds active ingredient per gallon.

Keep Out of Reach of Children
CAUTION / PRECAUCIÓN

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

Precautionary Statements

Hazards to Humans and Domestic Animals

Harmful if Swallowed, Absorbed Through Skin, or if Inhaled. Avoid breathing of dust or contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse.

ENVIRONMENTAL HAZARDS

Do not apply to water except as specified on the label. Do not contaminate water by disposal of equipment washwaters. Do not apply in tidewater/brackish water. Lowest rates should be used in shallow areas where the water depth is considerably less than the average depth of the entire treatment site, for example, shallow shoreline areas. Trees and shrubs growing in water treated with Sonar A.S. herbicide may occasionally develop chlorosis. Follow use directions carefully so as to minimize adverse effects on non-target organisms.

First Aid	
If in eyes	• Hold eye open and rinse slowly and gently with water for 15 - 20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15 - 20 minutes. • Call a poison control center or doctor for treatment advice.
If swallowed	• Call a poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by a poison control center or doctor. • Do not give anything by mouth to an unconscious person.
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.

EMERGENCY NUMBER
Have the product container or label with you when calling a poison control center or doctor, or going for treatment.
In case of emergency endangering health or the environment involving this product, call **INFOTRAC** at **1-800-535-5053**.

Notice: Read the entire label before using. Use only according to label directions. **Before buying or using this product, read *Warranty Disclaimer, Inherent Risks of Use,* and *Limitation of Remedies* inside label booklet.**

For product information, visit our web site at **www.sepro.com**.

Shake well before using.

EPA Reg. No. 67690-4
FPL081408

*Trademark of SePRO Corporation.
SePRO Corporation 11550 North Meridian Street, Suite 600, Carmel, IN 46032 U.S.A.

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.

Shake Well Before Using.

GENERAL INSTRUCTIONS

Sonar A.S. herbicide is a selective systemic aquatic herbicide for management of aquatic vegetation in fresh water ponds, lakes, reservoirs, drainage canals and irrigation canals, including dry or de-watered areas of these sites. Sonar A.S. is absorbed from water by plant shoots and from hydrosoil by the roots of aquatic vascular plants. For in-water treatments, it is important to maintain the specified concentration of Sonar A.S. in contact with the target plants for a minimum of 45 days. Rapid water movement or any condition which results in rapid dilution of Sonar A.S. in treated water will reduce its effectiveness. In susceptible plants, Sonar A.S. inhibits the formation of carotene. In the absence of carotene, chlorophyll is rapidly degraded by sunlight. Herbicidal symptoms of Sonar A.S. appear in seven to ten days and appear as white (chlorotic) or pink growing points. Under optimum conditions, 30 to 90 days are required before the desired level of aquatic plant management is achieved with Sonar A.S. Species susceptibility to Sonar A.S. may vary depending on time of year, stage of growth, and water movement. For best results, apply Sonar A.S. prior to initiation of weed growth or when weeds begin active growth. Application to mature target plants may require an application rate at the higher end of the specified rate range and may take longer to control.

Sonar A.S. is not corrosive to application equipment.

The label provides recommendations on the use of a chemical analysis for the active ingredient. SePRO Corporation recommends the use of an Enzyme-Linked Immunoassay (ELISA Test) for the determination of the active ingredient concentration in the water. Contact SePRO Corporation for the utilization of this test, known as a FasTEST*, for the incorporation of this analysis in your treatment program. Other proven chemical analyses for the active ingredient may also be used. The chemical analysis, a FasTEST, is referenced in this label as the preferred method for the rapid determination of the concentration of the active ingredient in the water.

Application rates are provided in ounces or quarts of Sonar A.S. to achieve a desired concentration of the active ingredient in parts per billion (ppb). **The maximum application rate or sum of all application rates is 90 ppb in ponds and 150 ppb in lakes, reservoirs and static canals per annual growth cycle.** This maximum concentration is the amount of product calculated as the target application rate, NOT determined by testing the residues of the active ingredient in the treated water.

GENERAL USE PRECAUTIONS

- **Obtain Required Permits:** Consult with appropriate state or local water authorities before applying this product. Permits may be required by state or local public agencies.
- **Chemigation:** Do not apply Sonar A.S. through any type of irrigation system.
- **Hydroponic Farming:** Do not use Sonar A.S. treated water for hydroponic farming.
- **Greenhouse and Nursery Plants:** Do not use Sonar A.S. treated water for irrigating greenhouse or nursery plants. Use of an approved assay should confirm that residues are <1 ppb.
- **WATER USE RESTRICTIONS FOLLOWING APPLICATIONS WITH SONAR A.S. (DAYS)**

Application Rate	Drinking†	Fishing	Swimming	Livestock/Pet Consumption	Irrigation††
Maximum Rate (150 ppb) or less	0	0	0	0	See irrigation instructions below

† Note below, under Potable Water Intakes, the information for application of Sonar A.S. within 1/4 mile (1,320 feet) of a functioning potable water intake.

†† Note below, under Irrigation, specific time frames or fluridone residues that provide the widest safety margin for irrigating with fluridone treated water.

- **Potable Water Intakes:** In lakes and reservoirs or other sources of potable water, **do not apply** Sonar A.S. at application rates greater than 20 ppb within one-fourth mile (1,320 feet) of any functioning potable water intake. At application rates of 6 - 20 ppb, Sonar A.S. **may be applied** where functioning potable water intakes are present. **NOTE: Existing potable water intakes which are no longer in use, such as those replaced by potable water wells or connections to a municipal water system, are not considered to be functioning potable water intakes.**

- **Irrigation:** Irrigation from a Sonar A.S. treated area may result in injury to the irrigated vegetation. Follow these precautions and inform those who irrigate from areas treated with Sonar A.S. of the irrigation time frames or water assay requirements presented in the table below. Follow the following time frames and assay directions to reduce the potential for injury to vegetation irrigated with water treated with Sonar A.S. Greater potential for crop injury occurs where Sonar A.S. treated water is applied to crops grown on low organic and sandy soils.

Days After Application			
Application Site	Established Tree Crops	Established Row Crops/ Turf/Plants	Newly Seeded Crops/Seedbeds or Areas to be Planted Including Overseeded Golf Course Greens
†Ponds and Static Canals	7	30	Assay required
Canals	7	14	Assay required
††Lakes and Reservoirs	7	14	Assay required
†††Dry or de-watered canals	0	0	†††

† For purposes of Sonar A.S. labeling, a pond is defined as a body of water 10 acres or less in size. A lake or reservoir is greater than 10 acres.

†† In lakes and reservoirs where one-half or greater of the body of water is treated, use the pond and static canal irrigation precautions. When applying Sonar A.S. to exposed sediments of aquatic sites such as lakes and reservoirs, follow these time frames prior to using water for irrigation once sites are reflooded.

††† When Sonar A.S. is applied to exposed sediments of dry or de-watered canals, allow canals to refill for a minimum of 24 hours before using water for irrigation.

Where the use of Sonar A.S. treated water is desired for irrigating crops prior to the time frames established above, the use of a FasTEST assay is recommended to measure the concentration in the treated water. Where a FasTEST has deteremined that the concentrations are less than 10 parts per billion, there are no irrigation precautions for irrigating established tree crops, established row crops or turf. **For tobacco, tomatoes, peppers or other plants within the Solanaceae Family and newly seeded crops or newly seeded grasses such as overseeded golf course greens, do not use Sonar A.S. treated water if measured fluridone concentrations are greater than 5 ppb. Furthermore, when rotating crops, do not plant members of the Solanceae family in land that has been previously irrigated with fluridone concentrations in excess of 5 ppb. It is recommended that an aquatic specialist be consulted prior to commencing irrigation of these sites.**

PLANT CONTROL INFORMATION

Sonar A.S. selectivity is dependent upon dosage, time of year, stage of growth, method of application and water movement. The following categories, controlled, partially controlled, and not controlled are provided to describe expected efficacy under ideal treatment conditions using higher to maximum label rates. Use of lower rates will increase selectivity of some species listed as controlled or partially controlled. Additional aquatic plants may be controlled, partially controlled, or tolerant to Sonar A.S. Consult an aquatic specialist prior to application of Sonar A.S. to determine a plant's susceptibility to Sonar A.S.

NOTE: algae (chara, nitella, and filamentous species) are not controlled by Sonar A.S.

VASCULAR AQUATIC PLANTS CONTROLLED BY SONAR A.S.

Floating Plants:

Common duckweed (*Lemna minor*)

Emersed Plants:

Spatterdock (*Nuphar luteum*)

Water-lily (*Nymphaea* spp.)

Submersed Plants:

Bladderwort (*Utricularia* spp.)

Common coontail (*Ceratophyllum demersum*)

Common Elodea (*Elodea canadensis*)

Egeria, Brazilian Elodea (*Egeria densa*)

Fanwort, Cabomba (*Cabomba caroliniana*)

Hydrilla (*Hydrilla verticillata*)

Naiad (*Najas* spp.)

Pondweed (*Potamogeton* spp., except Illinois pondweed)

Watermilfoil (*Myriophyllum* spp. except variable-leaf milfoil)

Shoreline Grasses:

Paragrass (*Urochloa mutica*)

VASCULAR AQUATIC PLANTS PARTIALLY CONTROLLED BY SONAR A.S.:

Floating Plants:

Common watermeal (*Wolffia columbiana*)†

Salvinia (*Salvinia* spp.)

Emersed Plants:

Alligatorweed (*Alternanthera philoxeroides*)

American lotus (*Nelumbo lutea*)

Cattail (*Typha* spp.)

Creeping waterprimrose (*Ludwigia peploides*)

Parrotfeather (*Myriophyllum aquaticum*)

Smartweed (*Polygonum* spp.)

Spatterdock (*Nuphar luteum*)

Spikerush (*Eleocharis* spp.)

Waterpurslane (*Ludwigia palustris*)

Watershield (*Brasenia schreberi*)

Submersed Plants:

Illinois pondweed (*Potamogeton illinoensis*)

Limnophila (*Limnophila sessiliflora*)

Tapegrass, American eelgrass (*Vallisneria americana*)

Watermilfoil–variable-leaf (*Myriophyllum heterophyllum*)

Shoreline Grasses:

Barnyardgrass (*Echinochloa crusgalli*)

Giant cutgrass (*Zizaniopsis miliacea*)

Reed canarygrass (*Philaris arundinaceae*)

Southern watergrass (*Hydrochloa caroliniensis*)

Torpedograss (*Panicum repens*)

†Partial control only with Sonar A.S. applied at the maximum labeled rate.

VASCULAR AQUATIC PLANTS NOT CONTROLLED BY SONAR A.S.:

Floating Plants:

Waterlettuce (*Pistia stratiotes*)

Emersed Plants:

American frogbit (*Limnobium spongia*)

Arrowhead (*Sagittaria* spp.)

Bacopa (*Bacopa* spp.)

Big floatingheart, banana lily (*Nymphoides aquatica*)

Bulrush (*Scirpus* spp.)

Pickerelweed, lanceleaf (*Pontederia* spp.)

Rush (*Juncus* spp.)

Water pennywort (*Hydrocotyle* spp.)

Shoreline Grasses:

Maidencane (*Panicum hemitomon*)

MIXING AND APPLICATION DIRECTIONS

The aquatic plants present in the treatment site should be identified prior to application to determine their susceptibility to Sonar A.S. It is important to determine the area (acres) to be treated and the average depth in order to select the proper application rate. Do not exceed the maximum labeled rate for a given treatment site per annual growth cycle.

Shake Sonar A.S. well before using. Add the specified amount of Sonar A.S. to water in the spray tank during the filling operation. Agitate while filling and during spraying. Surface or subsurface application of the spray can be made with conventional spray equipment. Sonar A.S. can also be applied near the surface of the hydrosoil using weighted trailing hoses. A spray volume of 5 to 100 gallons per acre may be used. Sonar A.S. may also be diluted with water and the concentrated mix metered into the pumping system.

Tank-Mix Directions

Sonar A.S. may be tank mixed with other aquatic herbicides and algaecides to enhance efficacy and plant selectivity. Refer to the companion herbicide or algaecide label for use directions, precautions, and restrictions on use.

Application to Ponds

Sonar A.S. may be applied to the entire surface area of a pond. For single applications, rates may be selected to provide 45 to 90 ppb to the treated water. Use the higher rate within the rate range where there is a dense weed mass, when treating more difficult to control species, and for ponds less than 5 acres in size with an average depth less than 4 feet. Application rates necessary to obtain these concentrations are shown in the following table. For additional application rate calculations, refer to the *Application Rate Calculation-Ponds, Lakes and Reservoirs* section of this label. Split or multiple applications may be used where dilution of treated water is anticipated; however, the sum of all applications must not exceed a total of 90 ppb per annual growth cycle.

Application Rates for Ponds

Average Water Depth of Treatment Site (feet)	Quarts of Sonar A.S. per Treated Surface Acre to Achieve 45 ppb to 90 ppb		Fluid Ounces of Sonar A.S.Per Treated Surface Acre to Achieve: 45 ppb to 90 ppb	
1	0.12	0.24	3.8	7.7
2	0.24	0.49	7.7	15.7
3	0.37	0.73	11.8	23.4
4	0.49	0.98	15.7	31.4
5	0.61	1.22	19.5	39.0
6	0.73	1.46	23.4	46.7
7	0.85	1.70	27.2	54.4
8	0.98	1.95	31.4	62.4
9	1.10	2.19	35.2	70.1
10	1.22	2.44	39.0	78.1

Application to Lakes and Reservoirs

The following treatments may be used for treating both whole lakes or reservoirs and partial areas of lakes or reservoirs (bays, etc.). For best results in treating partial lakes and reservoirs, Sonar A.S. treatment areas should be a minimum of 5 acres in size. Treatment of areas smaller than 5 acres or treatment of narrow strips such as boat lanes or shorelines may not produce satisfactory results due to dilution by untreated water. Rate ranges are provided as a guide to include a wide range of environmental factors, such as, target species, plant susceptibility, selectivity and other aquatic plant management objectives. Application rates and methods should be selected to meet the specific lake/reservoir aquatic plant management goals.

A. Whole Lake or Reservoir Treatments (Limited or No Water Discharge)

1. Single Application to Whole Lakes or Reservoirs

Where single applications to whole lakes or reservoirs are desired, apply Sonar A.S. at an application rate of 10 to 90 ppb. Application rates necessary to obtain these concentrations in treated water are shown in the following table. For additional rate calculations, refer to the *Application Rate Calculation — Ponds, Lakes, and Reservoirs* section of the label. Choose an application rate from the table below to meet the aquatic plant management objective. **Where greater plant selectivity is desired such as when controlling Eurasian watermilfoil and curlyleaf pondweed, choose an application rate lower in the rate range.** For other plant species, SePRO recommends contacting an aquatic specialist in determining when to choose application rates lower in the rate range to meet specific plant management goals. Use the higher rate within the rate range where there is a dense weed mass or when treating more difficult to control plant species. Retreatments may be required to control more difficult to control species or in the event of a heavy rainfall event where dilution of the treatment concentration has occurred. In these cases, a second application or more may be required; however, the sum of all

applications cannot exceed 150 ppb per annual growth cycle. Refer to the section of this label entitled, *Split or Multiple Applications to Whole Lakes or Reservoirs*, for guidelines and maximum rate allowed.

Single Application Rates

Average Water Depth of Treatment Site (feet)	Quarts of Sonar A.S. per Treated Surface Acre to Achieve 10 ppb to 90 ppb		Fluid Ounces of Sonar A.S.Per Treated Surface Acre to Achieve: 10 ppb to 90 ppb	
1	0.03	0.24	1.0	7.7
2	0.05	0.49	1.6	15.7
3	0.08	0.73	2.6	23.4
4	0.11	0.98	3.2	31.4
5	0.14	1.22	4.5	39.0
6	0.16	1.46	5.1	46.7
7	0.19	1.70	6.1	54.4
8	0.22	1.95	7.0	62.4
9	0.24	2.19	7.6	70.1
10	0.27	2.44	8.6	78.1
11	0.30	2.68	9.6	86.0
12	0.32	2.93	10.2	93.8
13	0.35	3.17	11.2	101.4
14	0.38	3.42	12.1	109.4
15	0.41	3.66	13.1	117.1
16	0.43	3.90	13.8	124.8
17	0.46	4.15	14.7	132.2
18	0.49	4.39	15.7	140.5
19	0.51	4.63	16.3	148.2
20	0.54	4.88	17.3	156.2

2. Split or Multiple Applications to Whole Lakes or Reservoirs

To meet certain plant management objectives, split or multiple applications may be desired in making whole lake treatments. Split or multiple application programs are desirable when the objective is to use the minimum effective dose and, through the use of a water analysis, e.g. a FasTEST, add additional Sonar A.S. to maintain this lower dose for the sufficient time to ensure efficacy and enhance selectivity. Water may be treated at an initial application of 4 to 50 ppb. Additional split applications should be conducted to maintain a sufficient concentration for a minimum of 45 days or longer. **In controlling Eurasian watermilfoil and curlyleaf pondweed and where greater plant selectivity is desired, choose an application rate lower in the rate range.** For other plant species, SePRO recommends contacting an aquatic specialist in determining when to choose application rates lower in the rate range to meet specific plant management goals. When utilizing split or multiple applications of Sonar A.S., the utilization of FasTEST is strongly recommended to determine the actual concentration in the water over time. For split or multiple applications, the sum of all applications must not exceed 150 ppb per annual growth cycle.

NOTE: In treating lakes or reservoirs that contain functioning potable water intakes and the application requires treating within 1/4 mile of a potable water intake, no single application can exceed 20 ppb. Additionally, the sum of all applications cannot exceed 150 ppb per annual growth cycle.

B. Partial Lake or Reservoir Treatments

Where dilution of Sonar A.S. with untreated water is anticipated, such as in partial lake or reservoir treatments, split or multiple applications may be used to extend the contact time to the target plants. The application rate and use frequency of Sonar A.S. in a partial lake is highly dependent upon the treatment area. An application rate at the higher end of the specified rate range may be required and frequency of applications will vary depending upon the potential of untreated water diluting the Sonar A.S. concentration in the treatment area. Use a rate at the higher end of the rate range where greater dilution with untreated water is anticipated.

1. Treatment Areas Greater Than 1/4 Mile from a Functioning Potable Water Intake

For single applications, apply Sonar A.S. at application rates from 30 to 150 ppb. Split or multiple applications may be made; however, the sum of all applications cannot exceed 150 ppb per annual growth cycle. Split applications should be conducted to maintain a sufficient concentration in the target area for a period of 45 days or longer. The use of a FasTEST is recommended to maintain the desired concentration in the target area over time.

2. Treatment Areas Within 1/4 Mile of a Functioning Potable Water Intake

In treatment areas that are within 1/4 mile of a potable water intake, no single application can exceed 20 ppb. When utilizing split or multiple applications of Sonar A.S. for sites which contain a potable water intake, a FasTEST is required to determine the actual concentration in the water. Additionally, the sum of all applications cannot exceed 150 ppb per annual growth cycle.

APPLICATION RATE CALCULATION – PONDS, LAKES AND RESERVOIRS

The amount of Sonar A.S. to be applied to provide the desired ppb concentration of active ingredient in treated water may be calculated as follows:

Quarts of Sonar A.S. required per treated surface acre = Average water depth of treatment site (feet) x Desired ppb concentration of active ingredient x 0.0027

For example, the quarts per acre of Sonar A.S. required to provide a concentration of 25 ppb of active ingredient in water with an average depth of 5 feet is calculated as follows:

5 x 25 x 0.0027 = 0.33 quarts per treated surface acre

When measuring quantities of Sonar A.S., quarts may be converted to fluid ounces by multiplying quarts to be measured x 32. For example, 0.33 quarts x 32 = 10.5 fluid ounces.

NOTE: Calculated rates may not exceed the maximum allowable rate in quarts per treated surface acre for the water depth listed in the application rate table for the site to be treated.

APPLICATION TO SEDIMENTS OF DRY OR DE-WATERED AQUATIC SITES

For application of Sonar A.S. to sediments of dry or de-watered aquatic sites, including exposed sediments of lakes or reservoirs, irrigation canals, non-irrigation canals and drainage canals, apply a maximum of 2 quarts of Sonar A.S. per surface acre per annual growth cycle. Apply Sonar A.S. evenly to the sediment surface, but not above the high water line, with a minimum spray solution of 30 to 100 gallons per surface acre. High levels of organic matter in treated sediments may reduce efficacy. Sonar A.S. may be applied with other aquatic herbicides labeled for this use. Please contact your SePRO Aquatic Specialist for further use recommendations.

APPLICATION TO DRAINAGE CANALS AND IRRIGATION CANALS

Static Canals: In static drainage and irrigation canals, apply Sonar A.S. at the rate of 30 to 150 ppb per treated surface acre. The maximum application rate or sum of all application rates cannot exceed 150 ppb per annual growth cycle.

Moving Water Canals: The performance of Sonar A.S. will be enhanced by restricting or reducing water flow. In slow moving bodies of water use an application technique that maintains a concentration of 15 - 40 ppb in the target area for a minimum of 45 days. Sonar A.S. can be applied by split or multiple broadcast applications or by metering in the product to provide a uniform concentration of the herbicide based upon the flow pattern. The use of a FasTEST is recommended to maintain the desired concentration in the target area over time.

Static or Moving Water Canals Containing a Functioning Potable Water Intake: In treating a static or moving water canal which contains a functioning potable water intake, applications of Sonar A.S. greater than 20 ppb must be made more than 1/4 mile from a functioning potable water intake. Applications less than 20 ppb may be applied within 1/4 mile from a functioning potable water intake; however, if applications of Sonar A.S. are made within 1/4 mile of a functioning potable water intake, a FasTEST must utilized to demonstrate that concentrations do not exceed 150 ppb at the functioning potable water intake.

APPLICATION RATE CALCULATION – MOVING WATER DRAINAGE AND IRRIGATION CANALS

The amount of Sonar A.S. to be applied through a metering system to provide the desired ppb concentration of active ingredient in treated water may be calculated as follows:

1. Average flow rate (feet per second) x average canal width (ft.) x average canal depth (ft.) x 0.9 = CFS (cubic feet per second).

2. CFS x 1.98 = acre feet per day (water movement).

3. Acre feet per day x desired ppb x 0.0027 = Quarts of Sonar A.S. required per day.

Storage and Disposal

Do not contaminate water, food, or feed by storage or disposal.

Pesticide Storage: Store in original container only. Do not store near feed or foodstuffs. In case of leak or spill, use absorbent materials to contain liquids and dispose as waste.

Pesticide Disposal: Wastes resulting from use of this product may be used according to label directions or disposed of at an approved waste disposal facility.

Nonrefillable Container Disposal (rigid, 5 gallons or less): Do not reuse or refill this container. Triple 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 the procedure two more times. Offer for recycling, if available.

Refillable Container Disposal (rigid, greater than 5 gallons): 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 mix tank. Fill the container about 10 percent full with water. Agitate vigorously or recirculate water with the pump for 2 minutes. Pour or pump rinsate into application equipment or rinsate collection system. Repeat this rinsing procedure two more times. Seal all openings which have been opened during use. Return the empty container to a collection site designated by SePRO Corporation. If the container has been damaged and cannot be returned according to the recommended procedures, contact SePRO Corporation at **1-800-419-7779** to obtain proper handling instructions.

Warranty Disclaimer

SePRO Corporation warrants that the product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. SEPRO CORPORATION MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.

Inherent Risks of Use

It is impossible to eliminate all risks associated with use of this product. Plant injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label such as unfavorable temperatures, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner or application, or other factors, all of which are beyond the control of SePRO Corporation as the seller. To the extent consistent with applicable law, all such risks shall be assumed by buyer.

Limitation of Remedies

To the extent consistent with applicable law, the exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability, or other legal theories) shall be limited to, at SePRO Corporation's election, one of the following:

(1) Refund of purchase price paid by buyer or user for product bought, or
(2) Replacement of amount of product used.

To the extent consistent with applicable law, SePRO Corporation shall not be liable for losses or damages resulting from handling or use of this product unless SePRO Corporation is promptly notified of such losses or damages in writing. In no case shall SePRO Corporation be liable for consequential or incidental damages or losses.

The terms of the *Warranty Disclaimer* above and this *Limitation of Remedies* cannot be varied by any written or verbal statements or agreements. No employee or sales agent of SePRO Corporation or the seller is authorized to vary or exceed the terms of the *Warranty Disclaimer* or *Limitations of Remedies* in any manner.

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Specimen Label

Sonar* PR

Aquatic Herbicide

An herbicide for management of aquatic vegetation in fresh water ponds, lakes, reservoirs, potable water sources, drainage canals, irrigation canals and rivers.

Active Ingredient	
Fluridone: 1-methyl-3-phenyl-5-[3-(trifluoromethyl) phenyl]-4(1*H*)-pyridinone	5.0%
Other Ingredients	95.0%
TOTAL	100.0%

Contains 0.05 pound active ingredient per pound.

Precautionary Statements

Hazards to Humans and Domestic Animals

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.)

Harmful if Swallowed, Absorbed Through Skin, or if Inhaled. Avoid breathing of dust or contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse.

ENVIRONMENTAL HAZARDS

Follow use directions carefully so as to minimize adverse effects on non-target organisms. Trees and shrubs growing in water treated with Sonar PR may occasionally develop chlorosis. Do not apply in tidewater/brackish water. Lowest rates should be used in shallow areas where the water depth is considerably less than the average depth of the entire treatment site, for example, shallow shoreline areas.

First Aid	
If in eyes	• Hold eye open and rinse slowly and gently with water for 15 - 20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15 - 20 minutes. • Call a poison control center or doctor for treatment advice.
If swallowed	• Call a poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by a poison control center or doctor. • Do not give anything by mouth to an unconscious person.
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.

EMERGENCY NUMBER
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. For medical emergencies involving this product, call **1-800-535-5053**.

Notice: Read the entire label before using. Use only according to label directions. **Before buying or using this product, read *Warranty Disclaimer, Inherent Risks of Use,*** and ***Limitation of Remedies*** inside label booklet.

For additional information on our products, please visit **www.sepro.com.**

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SePRO Corporation 11550 North Meridian Street, Suite 600, Carmel, IN 46032 U.S.A.

Directions for Use

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

Read all directions carefully before applying Sonar PR.

GENERAL INFORMATION

Sonar PR herbicide is a selective systemic aquatic herbicide for management of aquatic vegetation in fresh water ponds, lakes, reservoirs, drainage canals, irrigation canals, and rivers. Sonar PR is a pelleted formulation containing 5% fluridone. Sonar PR is absorbed from water by plant shoots and from hydrosoil by the roots of aquatic vascular plants. It is important to maintain Sonar PR in contact with the target plants for as long as possible. Rapid water movement or any condition which results in rapid dilution of Sonar PR in treated water will reduce its effectiveness.

In susceptible plants, Sonar PR inhibits the formation of carotene. In the absence of carotene, chlorophyll is rapidly degraded by sunlight. Herbicidal symptoms of Sonar PR appear in seven to ten days and appear as white (chlorotic) or pink growing points. Under optimum conditions 30 to 90 days are required before the desired level of aquatic weed management is achieved with Sonar PR. Species susceptibility to Sonar PR may vary depending on time of year, stage of growth and water movement. For best results, apply Sonar PR prior to initiation of weed growth or when weeds begin active growth. Application to mature target plants may require an application rate at the higher end of the specified rate range and may take longer to control.

Sonar PR is not corrosive to application equipment.

The label provides recommendations on the use of a chemical analysis for the active ingredient. SePRO Corporation recommends the use of an Enzyme-Linked Immunoassay (ELISA Test) for the determination of the active ingredient concentration in the water. Contact SePRO Corporation to incorporate this test, known as a FasTEST,* into your treatment program. Other proven chemical analyses for the active ingredient may also be used. The chemical analysis, a FasTEST, is referenced in this label as the preferred method for the rapid determination of the concentration of the active ingredient in the water.

Application rates are provided in pounds of Sonar PR to achieve a desired concentration of the active ingredient in parts per billion (ppb). **The maximum application rate or sum of all application rates is 90 ppb in ponds and 150 ppb in lakes and reservoirs per annual growth cycle.** This maximum concentration is the amount of product calculated as the target application rate, NOT determined by testing the residues of the active ingredient in the treated water.

GENERAL USE PRECAUTIONS

- **Obtain required permits:** Consult with appropriate state or local water authorities before applying this product. Permits may be required by state or local public agencies.

- **NEW YORK STATE:** Application of Sonar PR is not permitted in waters less than two (2) feet deep.

- **Hydroponic Farming:** Do not use Sonar PR treated water for hydroponic farming.

- **Greenhouse and Nursery Plants:** Do not use Sonar PR treated water for irrigating greenhouse or nursery plants unless a FasTEST assay has been run and confirmed that residues are less than 1 ppb.

- **Water use restrictions following applications with Sonar PR (Days)**

Application Rate	Drinking†	Fishing	Swimming	Livestock/Pet Consumption	Irrigation††
Maximum Rate (150 ppb) or less	0	0	0	0	See irrigation instructions below

† Note below, under *Potable Water Intakes*, the information for application of Sonar PR within 1/4 miles (1,320 feet) of a functioning potable water intake.

†† Note below, under *Irrigation*, specific time frames or fluridone residues that provide the widest safety margin for irrigating with fluridone treated water.

- **Potable Water Intakes:** Concentrations of the active ingredient fluridone up to 150 ppb are allowed in potable water sources; however, in lakes and reservoirs or other sources of potable water, **DO NOT APPLY** Sonar PR at application rates greater than 20 ppb within one-fourth (1/4) mile (1,320 feet) of any functioning potable water intake. At application rates of 8 - 20 ppb, Sonar PR **MAY BE APPLIED** where functioning potable water intakes are present. **Note: Existing potable water intakes which are no longer in use, such as those replaced by connections to potable water wells or a municipal water system, are not considered to be functioning potable water intakes.**

- **Irrigation:** Irrigation with Sonar PR treated water may result in injury to the irrigated vegetation. Follow these precautions and inform those who irrigate from areas treated with Sonar PR of the irrigation time frames or water FasTEST assay requirements presented in the table below. These time frames and a FasTEST assay recommendations are suggestions which should be followed to reduce the potential for injury to vegetation irrigated with water treated with Sonar PR. Greater potential for crop injury occurs where Sonar PR treated water is applied to crops grown on low organic and sandy soils.

Days After Application			
Application Site	Established Tree Crops	Established Row Crops/ Turf/Plants	Newly Seeded Crops/Seedbeds or Areas to be Planted Including Overseeded Golf Course Greens
Ponds and Static Canals†	7	30	FasTEST assay required
Canals	7	7	FasTEST assay required
Rivers	7	7	FasTEST assay required
Lakes and Reservoirs††	7	7	FasTEST assay required

† For purposes of Sonar PR labeling, a pond is defined as a body of water 10 acres or less in size. A lake or reservoir is greater than 10 acres.

†† In lakes and reservoirs where one-half or greater of the body of water is treated, use the pond and static canal irrigation precautions.

Where the use of Sonar PR treated water is desired for irrigating crops prior to the time frames established above, the use of a FasTEST assay is recommended to measure the concentration in the treated water. Where a FasTEST has determined that concentrations are less than 10 parts per billion, there are no irrigation precautions for irrigating established tree crops, established row crops or turf. **For tobacco, tomatoes, peppers or other plants within the Solanaceae Family and newly seeded crops or newly seeded grasses such as overseeded golf course greens, do not use Sonar PR treated water if concentrations are greater than 5 ppb; furthermore, when rotating crops, do not plant members of the Solanaceae family in land that has been previously irrigated with fluridone concentrations in excess of 5 ppb. It is recommended that an aquatic specialist be consulted prior to commencing irrigation of these sites.**

PLANT CONTROL INFORMATION

Sonar PR selectivity is dependent upon dosage, time of year, stage of growth, method of application, and water movement. The following categories, controlled, partially controlled, and not controlled are provided to describe expected efficacy under ideal treatment conditions using higher to maximum label rates. Use of lower rates will increase selectivity of some species listed as controlled or partially controlled. Additional aquatic plants may be controlled, partially controlled, or tolerant to Sonar PR. Consult an aquatic specialist prior to application of Sonar PR to determine a plant's susceptibility to Sonar PR.

VASCULAR AQUATIC PLANTS CONTROLLED BY SONAR PR[1]

Submersed Plants:

Bladderwort (*Utricularia* spp.)
Common coontail (*Ceratophyllum demersum*)†
Common Elodea (*Elodea canadensis*)†
Egeria, Brazilian Elodea (*Egeria densa*)
Fanwort, Cabomba (*Cabomba caroliniana*)
Hydrilla (*Hydrilla verticillata*)
Naiad (*Najas* spp.)†
Pondweed (*Potamogeton* spp., except Illinois pondweed)†
Watermilfoil (*Myriophyllum* spp. except variable-leaf milfoil)

Shoreline Grasses:

Paragrass (*Urochloa mutica*)

1 Species denoted by a dagger (†) are native plants that are often tolerant to fluridone at lower use rates. Please consult an aquatic specialist for recommended Sonar PR use rates (not to exceed maximum labeled rates) when selective control of exotic species is desired.

VASCULAR AQUATIC PLANTS PARTIALLY CONTROLLED BY SONAR PR PRECISION RELEASE:

Submersed Plants:

Illinois pondweed (*Potamogeton illinoensis*)
Limnophila (*Limnophila sessiliflora*)
Tapegrass, American eelgrass (*Vallisneria americana*)
Watermilfoil–variable-leaf (*Myriophyllum heterophyllum*)

Emersed Plants:

Alligatorweed (*Alternanthera philoxeroides*)
American lotus (*Nelumbo lutea*)
Cattail (*Typha* spp.)
Creeping waterprimrose (*Ludwigia peploides*)
Parrotfeather (*Myriophyllum aquaticum*)
Smartweed (*Polygonum* spp.)
Spatterdock (*Nuphar luteum*)
Spikerush (*Eleocharis* spp.)
Waterlily (*Nymphaea* spp.)
Waterpurslane (*Ludwigia palustris*)
Watershield (*Brasenia schreberi*)

Floating Plants:

Salvinia (*Salvinia* spp.)

Shoreline Grasses:

Barnyardgrass (*Echinochloa crusgalli*)
Giant cutgrass (*Zizaniopsis miliacea*)
Reed canarygrass (*Philaris arundinaceae*)
Southern watergrass (*Hydrochloa caroliniensis*)
Torpedograss (*Panicum repens*)

VASCULAR AQUATIC PLANTS NOT CONTROLLED BY SONAR PR PRECISION RELEASE:

Emersed Plants:

American frogbit (*Limnobium spongia*)

Arrowhead (*Sagittaria* spp.)

Bacopa (*Bacopa* spp.)

Big floatingheart, banana lily (*Nymphoides aquatica*)

Bulrush (*Scirpus* spp.)

Pickerelweed, lanceleaf (*Pontederia* spp.)

Rush (*Juncus* spp.)

Water pennywort (*Hydrocotyle* spp.)

Floating Plants:

floating waterhyacinth (*Eichhornia crassipes*)

waterlettuce (*Pistia stratiotes*)

Shoreline Grasses:

Maidencane (*Panicum hemitomon*)

NOTE: Algae (chara, nitella, and filamentous species) are not controlled by Sonar PR.

APPLICATION DIRECTIONS

The aquatic plants present in the treatment site should be identified prior to application to determine their susceptibility to Sonar PR. It is important to determine the area (acres) to be treated and the average depth in order to select the proper application rate. Do not exceed the maximum labeled rate for a given treatment site per annual growth cycle.

Application to Ponds

Sonar PR may be applied to the entire surface area of a pond. For single applications, rates may be selected to provide 45 to 90 ppb to the treated water, although actual concentrations in treated water may be substantially lower at any point in time due to the slow-release formulation of this product. When treating for optimum selective control, lower rates may be applied for sensitive target species. Use the higher rate within the rate range where there is a dense weed mass, when treating more difficult to control species, and for ponds less than 5 acres in size with an average depth less than 4 feet. Application rates necessary to obtain these concentrations in treated water are shown in the following table. For additional application rate calculations, refer to the *Application Rate Calculation—Ponds, Lakes and Reservoirs* section of this label. Split or multiple applications may be used where dilution of treated water is anticipated; however, the sum of all applications should total 45 to 90 ppb and must not exceed a total of 90 ppb per annual growth cycle.

Average Water Depth of Treatment Site (feet)	Pounds of Sonar PR per treated surface acre	
	45 ppb	90 ppb
1	2.5	5.0
2	5.0	10.0
3	7.5	15.0
4	10.0	20.0
5	12.5	25.0
6	15.0	30.0
7	17.0	34.0
8	19.5	39.0
9	22.0	44.0
10	24.5	49.0

Application to Lakes and Reservoirs

The following treatments may be used for treating both whole lakes or reservoirs and partial areas of lakes or reservoirs (bays, etc.). For best results in treating partial lakes and reservoirs, Sonar PR treatment areas should be a minimum of 5 acres in size. Treatment of areas smaller than 5 acres or treatment of narrow strips such as boat lanes or shorelines may not produce satisfactory results due to dilution by untreated water. Rate ranges are provided as a guide to include a wide range of environmental factors, such as target species, plant susceptibility, selectivity and other aquatic plant management objectives. Application rates and methods should be selected to meet the specific lake/reservoir aquatic plant management goals.

A. Whole Lake or Reservoir Treatments

(Limited or No Water Discharge)

1. Single Application to Whole Lakes or Reservoirs

Where single applications to whole lakes or reservoirs are desired, apply Sonar PR at an application rate of 16 to 90 ppb. Application rates necessary to obtain these concentrations in treated water are shown in the following table. For additional application rate calculations, refer to the *Application Rate Calculation—Ponds, Lakes and Reservoirs* section of this label. Choose an application rate from the table below to meet the aquatic plant management objective. **Where greater plant selectivity is desired such as when controlling Eurasian watermilfoil and curlyleaf pondweed, choose an application rate lower in the rate range.** For other plant species, SePRO recommends contacting an aquatic specialist in determining when to choose application rates lower in the rate range to meet specific plant management goals. Use the higher rate within the rate range where there is a dense weed mass or when treating more difficult to control plant species or in the event of a heavy rainfall event where dilution has occurred. In these cases, a second application or more may be required; however, the sum of applications cannot exceed 150 ppb per annual growth cycle. Refer to the section of this label entitled, *Split or Multiple Applications to Whole Lakes or Reservoirs*, for guidelines and maximum rate allowed.

Average Water Depth of Treatment Site (feet)	Pounds of Sonar PR per treated surface acre	
	16 ppb	90 ppb
1	0.9	5.0
2	1.7	10.0
3	2.6	15.0
4	3.5	20.0
5	4.3	25.0
6	5.2	30.0
7	6.0	34.0
8	6.9	39.0
9	7.8	44.0
10	8.6	49.0
11	9.5	54.0
12	10.4	59.0
13	11.2	64.0
14	12.1	68.0
15	13.0	73.0
16	13.8	78.0
17	14.7	83.0
18	15.6	88.0
19	16.4	93.0
20	17.3	98.0

2. Split or Multiple Applications to Whole Lakes or Reservoirs

To meet certain plant management objectives, split or multiple applications may be desired in making whole lake treatments. Split or multiple application programs are desirable when the objective is to use the minimum effective dose and to maintain this lower dose for the sufficient time to ensure efficacy and enhance selectivity. Under these situations, use the lower rates (16 to 75 ppb) within the rate range. **In controlling Eurasian watermilfoil and curlyleaf pondweed and where greater plant selectivity is desired, choose an application rate lower in the rate range.** For other plant species, SePRO recommends contacting an aquatic specialist in determining when to choose application rates lower in the rate range to meet specific plant management goals. For split or repeated applications, the sum of all applications must not exceed 150 ppb per annual growth cycle.

NOTE: In treating lakes or reservoirs that contain potable water intakes and the application requires treating within 1/4 mile of a potable water intake, no single application can exceed 20 ppb. Additionally, the sum of all applications cannot exceed 150 ppb per annual growth cycle.

B. Partial Lake or Reservoir Treatments

Where dilution of Sonar PR with untreated water is anticipated, such as in partial lake or reservoir treatments, split or multiple applications may be used to extend the contact time to the target plants. The application rate and use frequency of Sonar PR in a partial lake is highly dependent upon the treatment area.

An application rate at the higher end of the specified rate range may be required and frequency of applications will vary depending upon the potential of untreated water diluting the Sonar PR concentration in the treatment area. Use a rate at the higher end of the rate range where greater dilution with untreated water is anticipated.

1. Application Sites Greater Than 1/4 Mile from a Functioning Potable Water Intake

For single applications, apply Sonar PR at application rates from 45 to150 ppb. Split or multiple applications may be made; however, the sum of all applications cannot exceed 150 ppb per annual growth cycle. Split applications should be conducted to maintain a sufficient concentration in the target area for a period of 45 days or longer. The use of a FasTEST is recommended to maintain the desired concentration in the target area over time.

2. Application Sites Within 1/4 Mile of a Functioning Potable Water Intake

In treatment areas that are within 1/4 mile of a potable water intake, no single application can exceed 20 ppb. When utilizing split or repeated applications of Sonar PR for sites which contain a potable water intake, a FasTEST is required to determine the actual concentration in the water. Additionally, the sum of all applications cannot exceed 150 ppb per annual growth cycle.

APPLICATION RATE CALCULATION – PONDS, LAKES AND RESERVOIRS

The amount of Sonar PR to be applied to provide the desired ppb concentration of active ingredient equivalents in treated water may be calculated as follows:

- **Pounds of Sonar PR required per treated acre =** Average water depth of treatment site **x** Desired ppb concentration of active ingredient equivalents **x** 0.054

For example, the pounds per acre of Sonar PR required to provide a concentration of 25 ppb of active ingredient equivalents in water with an average depth of 5 feet is calculated as follows:

5 **x** 25 **x** 0.054 **=** 6.75 pounds per treated surface acre.

NOTE: Calculated rates may not exceed the maximum allowable rate in pounds per treated surface acre for the water depth listed in the application rate table for the site to be treated.

APPLICATION TO DRAINAGE CANALS, IRRIGATION CANALS AND RIVERS

Static Canals: In static drainage and irrigation canals, apply Sonar PR at the rate of 20 to 40 pounds per surface acre.

Moving Water Canals and Rivers: The performance of Sonar PR will be enhanced by restricting or reducing water flow. In slow moving bodies of water use an application technique that maintains a concentration of 10 to 40 ppb in the applied area for a minimum of 45 days. Sonar PR can be applied by split or multiple broadcast applications or by metering in the product to provide a uniform concentration of the herbicide based upon the flow pattern. The use of a FasTEST is recommended to maintain the desired concentration in the target area over time.

Static or Moving Water Canals or Rivers Containing a Functioning Potable Water Intake: In treating a static or moving water canal or river which contains a functioning potable water intake, applications of Sonar PR greater than 20 ppb must be made more than 1/4 mile from a functioning potable water intake. Applications less than 20 ppb may be applied within 1/4 mile from a functioning potable water intake; however, if applications of Sonar PR are made within 1/4 mile from a functioning water intake, a FasTEST must be utilized to demonstrate that concentrations do not exceed 150 ppb at the potable water intake.

APPLICATION RATE CALCULATION – DRAINAGE CANALS, IRRIGATION CANALS AND RIVERS

The amount of Sonar PR to be applied through a metering system to provide the desired ppb concentration of active ingredient in treated water may be calculated as follows:

1. Average flow rate (feet per second) **x** average width (ft.) **x** average depth (ft.) x 0.9 **=** CFS (cubic feet per second)

2. CFS **x** 1.98 **=** acre feet per day (water movement)

3. Acre feet per day **x** desired ppb **x** 0.054 **=** pounds Sonar PR Precision Release required per day

Storage and Disposal

Do not contaminate water, food or feed by storage or disposal.

Pesticide Storage: Store in original container only. Do not store near feed or foodstuffs. In case of spill, contain material and dispose as waste.

Pesticide Disposal: Wastes resulting from use of this product may be used according to label directions or disposed of at an approved waste disposal facility.

Nonrefillable Container Disposal (rigid, ≤ 50 pounds): Do not reuse or refill this container. Triple rinse (or equivalent). Then offer for recycling (if available) or reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration, or if allowed by State and Local authorities, by burning. If burned, stay out of smoke.

Refillable Container Disposal: 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 mix tank. Fill the container about 10 percent full with water. Agitate vigorously or recirculate water with the pump for 2 minutes. Pour or pump rinsate into application equipment or rinsate collection system. Repeat this rinsing procedure two more times. Seal all openings which have been opened during use. Return the empty container to a collection site designated by SePRO Corporation. If the container has been damaged and cannot be returned according to the recommended procedures, contact SePRO Corporation at 1-800-419-7779 to obtain proper handling instructions.

Warranty Disclaimer

SePRO Corporation warrants that the product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. To the extent consistent with applicable law, SEPRO CORPORATION MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.

Inherent Risks of Use

It is impossible to eliminate all risks associated with use of this product. Plant injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label such as unfavorable temperatures, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner or application, or other factors, all of which are beyond the control of SePRO Corporation as the seller. To the extent consistent with applicable law, all such risks shall be assumed by buyer.

Limitation of Remedies

To the extent consistent with applicable law, the exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability, or other legal theories) shall be limited to, at SePRO Corporation's election, one of the following:

(1) Refund of purchase price paid by buyer or user for product bought, or
(2) Replacement of amount of product used.

To the extent consistent with applicable law, SePRO Corporation shall not be liable for losses or damages resulting from handling or use of this product unless SePRO Corporation is promptly notified of such losses or damages in writing. In no case shall SePRO Corporation be liable for consequential or incidental damages or losses.

The terms of the *Warranty Disclaimer* above and this *Limitation of Remedies* can not be varied by any written or verbal statements or agreements. No employee or sales agent of SePRO Corporation or the seller is authorized to vary or exceed the terms of the *Warranty Disclaimer* or *Limitations of Remedies* in any manner.

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Specimen Label

Sonar* Q

Aquatic Herbicide

An herbicide for management of aquatic vegetation in fresh water ponds, lakes, reservoirs, potable water sources, drainage canals, irrigation canals and rivers.

Active Ingredient

Fluridone:

1-methyl-3-phenyl-5-[3-(trifluoromethyl)phenyl]

-4(1*H*)-pyridinone 5.0%

Other Ingredients 95.5%

TOTAL 100.0%

Contains 0.05 pounds active ingredient per pound.

Keep Out of Reach of Children

CAUTION / PRECAUCIÓN

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

Precautionary Statements

Hazards to Humans and Domestic Animals

Harmful if Swallowed, Absorbed Through Skin, or if Inhaled

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

ENVIRONMENTAL HAZARDS

Follow use directions carefully so as to minimize adverse effects on non-target organisms. In order to avoid impact on threatened or endangered aquatic plant or animal species, users must consult their State Fish and Game Agency or the U.S. Fish and Wildlife Service before making applications.

Trees and shrubs growing in water treated with Sonar Q may occasionally develop chlorosis. Do not apply in tidewater/brackish water.

Lowest rates should be used in shallow areas where the water depth is considerably less than the average depth of the entire treatment site, for example, shallow shoreline areas.

First Aid	
If in eyes	• Hold eye open and rinse slowly and gently with water for 15 - 20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call poison control center or doctor for treatment advice.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15 – 20 minutes. • Call a poison control center or doctor for treatment advice.
If swallowed	• Call a poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by a poison control center or doctor. • Do not give anything by mouth to an unconscious person.
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.

EMERGENCY NUMBER

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. In case of emergency endangering health or the environment involving this product, call **INFOTRAC** at **1-800-535-5053**.

Refer to inside of label booklet for additional precautionary information and Directions for Use.

Notice: Read the entire label before using. Use only according to label directions. **Before buying or using this product, read "Warranty Disclaimer", "Inherent Risks of Use"** and **"Limitation of Remedies"** inside label booklet.

For product information, visit our web site at **www.sepro.com**.

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FPL 060206

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SePRO Corporation Carmel, IN 46032 U.S.A.

Directions for Use

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

Read all Directions Carefully Before Applying Sonar Q.

GENERAL INSTRUCTIONS

Sonar Q herbicide is a selective systemic aquatic herbicide for management of aquatic vegetation in fresh water ponds, lakes, reservoirs, drainage canals, irrigation canals, and rivers. Sonar Q is a pelleted formulation containing 5% fluridone. Sonar is absorbed from water by plant shoots and from hydrosoil by the roots of aquatic vascular plants. It is important to maintain Sonar in contact with the target plants for as long as possible. Rapid water movement or any condition which results in rapid dilution of Sonar in treated water will reduce its effectiveness. In susceptible plants, Sonar inhibits the formation of carotene. In the absence of carotene, chlorophyll is rapidly degraded by sunlight. Herbicidal symptoms of Sonar appear in seven to ten days and appear as white (chlorotic) or pink growing points. Under optimum conditions 30 to 90 days are required before the desired level of aquatic weed management is achieved with Sonar. Species susceptibility to Sonar Q may vary depending on time of year, stage of growth and water movement. For best results, apply Sonar Q prior to initiation of weed growth or when weeds begin active growth. Application to mature target plants may require higher application rates and may take longer to control.

Sonar Q is not corrosive to application equipment.

The label provides recommendations on the use of a chemical analysis for the active ingredient. SePRO Corporation recommends the use of an Enzyme-Linked Immunoassay (ELISA Test) for the determination of the active ingredient concentration in the water. Contact SePRO Corporation to incorporate this test, known as a FasTEST*, into your treatment program. Other proven chemical analyses for the active ingredient may also be used. The chemical analysis, FasTEST, is referenced in this label as the preferred method for the rapid determination of the concentration of the active ingredient in the water.

Application rates are provided in pounds of Sonar Q to achieve a desired concentration of the active ingredient in part per billion (ppb). The maximum application rate or sum of all application rates is 90 ppb in ponds and 150 ppb in lakes and reservoirs per annual growth cycle. This maximum concentration is the amount of product calculated as the target application rate, NOT determined by testing the residues of the active ingredient in the treated water.

GENERAL USE PRECAUTIONS

- **Obtain required permits:** Consult with appropriate state or local water authorities before applying this product. Permits may be required by state or local public agencies.

- **NEW YORK STATE:** Application of Sonar Q is not permitted in waters less than two (2) feet deep.

- **Hydroponic Farming:** Do not use Sonar Q treated water for hydroponic farming.

- **Greenhouse and Nursery Plants:** Do not use Sonar Q treated water for irrigating greenhouse or nursery plants. Use of an approved assay should confirm that residues are <1 ppb.

- **Water Use Restrictions Following Applications with Sonar Q (Days)**

Application Rate	Drinking†	Fishing	Swimming	Livestock/Pet Consumption	Irrigation††
Maximum Rate (150 ppb) or less	0	0	0	0	See irrigation instructions below

† Note below, under Potable Water Intakes, the information for application of Sonar Q within 1/4 miles, (1320 feet) of a functioning potable water intake.

††Note below, under Irrigation, specific time frames or fluridone residues that provide the widest safety margin for irrigating with fluridone treated water.

- **Potable Water Intakes:** Concentrations of the active ingredient fluridone up to 150 ppb are allowed in potable water sources; however, in lakes and reservoirs or other sources of potable water, **DO NOT APPLY** Sonar Q at application rates greater than 20 ppb within one-fourth mile (1320 feet) of any functioning potable water intake. At application rates of 8 - 20 ppb, Sonar Q **MAY BE APPLIED** where functioning potable water intakes are present.
  Note: Existing potable water intakes which are no longer in use, such as those replaced by connections to potable water wells or a municipal water system, are not considered to be functioning potable water intakes.

- **Irrigation:** Irrigation with Sonar Q treated water may result in injury to the irrigated vegetation. SePRO Corporation recommends following these precautions and informing those who irrigate from areas treated with Sonar Q of the irrigation time frames or water assay requirements presented in the table below. These time frames and assay recommendations are suggestions which should be followed to reduce the potential for injury to vegetation irrigated with water treated with Sonar Q. Greater potential for crop injury occurs where Sonar Q treated water is applied to crops grown on low organic and sandy soils.

Days After Application			
Application Site	Established Tree Crops	Established Row Crops/ Turf/Plants	Newly Seeded Crops/Seedbeds or Areas to be Planted Including Overseeded Golf Course Greens
†Ponds and Static Canals	7	30	Assay required
Canals	7	7	Assay required
Rivers	7	7	Assay required
††Lakes and Reservoirs	7	7	Assay required

† For purposes of Sonar Q labeling, a pond is defined as a body of water 10 acres or less in size. A lake or reservoir is greater than 10 acres.

†† In lakes and reservoirs where one-half or greater of the body of water is treated, use the pond and static canal irrigation precautions.

Where the use of Sonar Q treated water is desired for irrigating crops prior to the time frames established above, the use of FasTEST assay is recommended to measure the concentration in the treated water. Where FasTEST has determined that concentrations are less than 10 parts per billion, there are no irrigation precautions for irrigating established tree crops, established row crops or turf. **For tobacco, tomatoes, peppers or other plants within the Solanaceae Family and newly seeded crops or newly seeded grasses such as overseeded golf course greens, do not use Sonar Q treated water if concentration are greater than 5 ppb; furthermore, when rotating crops, do not plant members of the Solanaceae family in land that has been previously irrigated with fluridone concentrations in excess of 5 ppb. It is recommended that an aquatic specialist be consulted prior to commencing irrigation of these sites.**

PLANT CONTROL INFORMATION

Sonar Q selectivity is dependent upon dosage, time of year, stage of growth, method of application, and water movement. The following categories, controlled, partially controlled, and not controlled are provided to describe expected efficacy under ideal treatment conditions using higher to maximum label rates. Use of lower rates will increase selectivity of some species listed as controlled or partially controlled. Additional aquatic plants may be controlled, partially controlled, or tolerant to Sonar Q. Consult an aquatic specialist prior to application of Sonar Q to determine a plant's susceptibility to Sonar Q.

VASCULAR AQUATIC PLANTS CONTROLLED BY SONAR Q†

Submersed Plants:

Bladderwort (*Utricularia* spp.)
Common coontail (*Ceratophyllum demersum*)
Common Elodea (*Elodea canadensis*)
Egeria, Brazilian Elodea (*Egeria densa*)
Fanwort, Cabomba (*Cabomba caroliniana*)
Hydrilla (*Hydrilla verticillata*)
Naiad (*Najas* spp.)
Pondweed (*Potamogeton* spp., except Illinois pondweed)
Watermilfoil (*Myriophyllum* spp. except variable-leaf milfoil)

Shoreline Grasses:

Paragrass (*Urochloa mutica*)

†Species denoted by an asterisk are native plants that are often tolerant to Sonar at lower use rates. Please consult an aquatic specialist for recommended Sonar Q use rates when selective control of exotic species is desired.

VASCULAR AQUATIC PLANTS PARTIALLY CONTROLLED BY SONAR Q

Floating Plants:

Salvinia (*Salvinia* spp.)

Emersed Plants:

Alligatorweed (*Alternanthera philoxeroides*)
American lotus (*Nelumbo lutea*)
Cattail (*Typha* spp.)
Creeping waterprimrose (*Ludwigia peploides*)
Parrotfeather (*Myriophyllum aquaticum*)
Smartweed (*Polygonum* spp.)
Spatterdock (*Nuphar luteum*)
Spikerush (*Eleocharis* spp.)
Waterlily (*Nymphaea* spp.)
Waterpurslane (*Ludwigia palustris*)
Watershield (*Brasenia schreberi*)

Submersed Plants:

Illinois pondweed (*Potamogeton illinoensis*)
Limnophila (*Limnophila sessiliflora*)
Tapegrass, American eelgrass (*Vallisneria americana*)
Watermilfoil–variable-leaf (*Myriophyllum heterophyllum*)

Shoreline Grasses:

Barnyardgrass (*Echinochloa crusgalli*)
Giant cutgrass (*Zizaniopsis miliacea*)
Reed canarygrass (*Philaris arundinaceae*)
Southern watergrass (*Hydrochloa caroliniensis*)
Torpedograss (*Panicum repens*)

VASCULAR AQUATIC PLANTS NOT CONTROLLED BY SONAR Q

Floating Plants:

Floating waterhyacinth (*Eichhornia crassipes*)

Waterlettuce (*Pistia stratiotes*)

Emersed Plants:

American frogbit (*Limnobium spongia*)

Arrowhead (*Sagittaria* spp.)

Bacopa (*Bacopa* spp.)

Big floatingheart, banana lily (*Nymphoides aquatica*)

Bulrush (*Scirpus* spp.)

Pickerelweed, lanceleaf (*Pontederia* spp.)

Rush (*Juncus* spp.)

Water pennywort (*Hydrocotyle* spp.)

Shoreline Grasses:

Maidencane (*Panicum hemitomon*)

NOTE: Algae (chara, nitella, and filamentous species are not controlled by Sonar Q).

APPLICATION DIRECTIONS

The aquatic plants present in the treatment site should be identified prior to application to determine their susceptibility to Sonar Q. It is important to determine the area (acres) to be treated and the average depth in order to select the proper application rate. Do not exceed the maximum labeled rate for a given treatment site per annual growth cycle.

Application to Ponds

Sonar Q may be applied to the entire surface area of a pond. For single applications, rates may be selected to provide 45 to 90 ppb to the treated water, although actual concentrations in treated water may be substantially lower at any point in time due to the slow-release formulation of this product. When treating for optimum selective control, lower rates may be applied for sensitive target species. Use the higher rate within the rate range where there is a dense weed mass, when treating more difficult to control species, and for ponds less than 5 acres in size with an average depth less than 4 feet. Application rates necessary to obtain these concentrations in treated water are shown in the following table. For additional application rate calculations, refer to *Application Rate Calculations – Ponds, Lakes and Reservoirs*. Split or multiple applications are recommended where dilution of treated water is anticipated; however, the sum of all applications should total 45 to 90 ppb and must not exceed a total of 90 ppb per annual growth cycle.

Application Rates for Ponds

Average Water Depth of Treatment Site (feet)	Pounds of Sonar Q per treated surface acre 45 ppb to 90 ppb	
1	2.5	5
2	5	10
3	7.5	15
4	10	20
5	12.5	25
6	15	30
7	17	34
8	19.5	39
9	22	44
10	24.5	49

Application to Lakes and Reservoirs

The following treatments are recommended for treating both whole lakes or reservoirs and partial areas of lakes or reservoirs (bays, etc.). For best results in treating partial lakes and reservoirs, Sonar Q treatment areas should be a minimum of 5 acres in size. Treatment of areas smaller than 5 acres or treatment of narrow strips such as boat lanes or shorelines may not produce satisfactory results due to dilution by untreated water. Rate ranges are provided as a guide to include a wide range of environmental factors, such as target species, plant susceptibility, selectivity and other aquatic plant management objectives. Application rates and methods should be selected to meet the specific lake/reservoir aquatic plant management goals.

A. Whole Lake or Reservoir Treatments (Limited or No Water Discharge)

1. Single Application to Whole Lakes or Reservoirs

Where single applications to whole lakes or reservoirs are desired, apply Sonar Q at an application rate of 16 to 90 ppb. Application rates necessary to obtain these concentrations in treated water are shown in the following table. For additional rate calculations, refer to *Application Rate Calculation – Ponds, Lakes and Reservoirs*. Choose an application rate to meet the aquatic plant management objective. **Where greater plant selectivity is desired such as when controlling Eurasian watermilfoil and curlyleaf pondweed, choose an application rate lower in the rate range.** For other plant species, SePRO recommends contacting an aquatic specialist in determining when to choose application rates lower in the rate range to meet specific plant management goals. Use the higher rate within the rate range where there is a dense weed mass or when treating more difficult to control plant species or in the event of a heavy rainfall event where dilution has occurred. In these cases, a second application or more may be required; however, the sum of all applications cannot exceed 150 ppb per annual growth cycle. Refer to the following Section (No. 2) *Split or Multiple Applications* for guidelines and maximum rate allowed.

Single Application Rates

Average Water Depth of Treatment Site (feet)	Pounds of Sonar Q per treated surface acre 45 ppb to 90 ppb	
1	0.9	5
2	1.7	10
3	2.6	15
4	3.5	20
5	4.3	25
6	5.2	30
7	6.0	34
8	6.9	39
9	7.8	44
10	8.6	49
11	9.5	54
12	10.4	59
13	11.2	64
14	12.1	68
15	13.0	73
16	13.8	78
17	14.7	83
18	15.6	88
19	16.4	93
20	17.3	98

2. Split or Multiple Applications to Whole Lakes or Reservoirs

To meet certain plant management objectives, split or multiple applications may be desired in making whole lake treatments. Split or multiple application programs are desirable when the objective is to use the minimum effective dose and to maintain this lower dose for the sufficient time to ensure efficacy and enhance selectivity. Under these situations, use the lower rates (16 to 75 ppb) within the rate range. **In controlling Eurasian watermilfoil and curlyleaf pondweed and where greater plant selectivity is desired, choose an application rate lower in the rate range.** For other plant species, SePRO recommends contacting an aquatic specialist in determining when to choose application rates lower in the rate range to meet specific plant management goals. For split or repeated applications, the sum of all applications must not exceed 150 ppb per annual growth cycle.

NOTE: In treating lakes or reservoirs that contain potable water intakes and the application requires treating within 1/4 mile of a potable water intake, no single application can exceed 20 ppb. Additionally, the sum of all applications cannot exceed 150 ppb per annual growth cycle.

B. Partial Lake or Reservoir Treatments

Where dilution of Sonar Q with untreated water is anticipated, such as in partial lake or reservoir treatments, split or multiple applications may be used to extend the contact time to the target plants. The application rate and use frequency of Sonar Q in a partial lake is highly dependent upon the treatment area. Higher application rates may be required and frequency of applications will vary depending upon the potential of untreated water diluting the Sonar Q concentration in the treatment area. Use higher rates where greater dilution with untreated water is anticipated.

1. Application Sites Greater Than 1/4 Mile from a Functioning Potable Water Intake

For single applications, apply Sonar Q at application rates from 45 to 150 ppb. Split or multiple applications may be made; however, the sum of all applications cannot exceed 150 ppb per annual growth cycle. Split applications should be conducted to maintain a sufficient concentration in the target area for a period of 45 days or longer. The use of FasTEST is recommended to maintain the desired concentration in the target area over time.

2. Application Sites Within 1/4 Mile of a Functioning Potable Water Intake

In treatment areas that are within 1/4 mile of a potable water intake, no single application can exceed 20 ppb. When utilizing split or repeated applications of Sonar Q for sites which contain a potable water intake, FasTEST is required to determine the actual concentration in the water. Additionally, the sum of all applications cannot exceed 150 ppb per annual growth cycle.

APPLICATION RATE CALCULATION – PONDS, LAKES AND RESERVOIRS

The amount of Sonar Q to be applied to provide the desired ppb concentration of active ingredient equivalents in treated water may be calculated as follows:

- Pounds of Sonar Q required per treated acre **=** Average water depth of treatment site **x** Desired ppb concentration of active ingredient equivalents **x** 0.054

For example, the pounds per acre of Sonar Q required to provide a concentration of 25 ppb of active ingredient equivalents in water with an average depth of 5 feet is calculated as follows:

5 **x** 25 **x** 0.054 **=** 6.75 pounds per treated surface acre.

NOTE: Calculated rates should not exceed the maximum allowable rate in pounds per treated surface acre for the water depth listed in the application rate table for the site to be treated.

APPLICATION TO DRAINAGE CANALS, IRRIGATION CANALS AND RIVERS

Static Canals: In static drainage and irrigation canals, Sonar Q should be applied at the rate of 20 to 40 pounds per surface acre.

Moving Water Canals and Rivers: The performance of Sonar Q will be enhanced by restricting or reducing water flow. In slow moving bodies of water use an application technique that maintains a concentration of 10 to 40 ppb in the applied area for a minimum of 45 days. Sonar Q can be applied by split or multiple broadcast applications or by metering in the product to provide a uniform concentration of the herbicide based upon the flow pattern. The use of FasTEST is recommended to maintain the desired concentration in the target area over time.

Static or Moving Water Canals or Rivers Containing a Functioning Potable Water Intake: In treating a static or moving water canal or river which contains a functioning potable water intake, applications of Sonar Q greater than 20 ppb must be made more than 1/4 mile from a functioning potable water intake. Applications less than 20 ppb may be applied within 1/4 mile from a functioning potable water intake; however, if applications of Sonar Q are made within 1/4 mile from a functioning water intake, the FasTEST must be utilized to demonstrate that concentrations do not exceed 150 ppb at the potable water intake.

APPLICATION RATE CALCULATION – DRAINAGE CANALS, IRRIGATION CANALS AND RIVERS

The amount of Sonar Q to be applied through a metering system to provide the desired ppb concentration of active ingredient in treated water may be calculated as follows:

1. Average flow rate (feet per second) **x** average width (ft.) **x** average depth (ft.) x 0.9 **=** CFS (cubic feet per second)

2. CFS **x** 1.98 **=** acre feet per day (water movement)

3. Acre feet per day **x** desired ppb **x** 0.054 **=** pounds Sonar Q required per day

Storage and Disposal

Do not contaminate water, food or feed by storage or disposal.

Pesticide Storage: Store in original container only. Do not store near feed or foodstuffs. In case of leak or spill, contain material and dispose as waste.
Pesticide Disposal: Wastes resulting from use of this product may be used according to label directions or disposed of at an approved waste disposal facility.
Container Disposal: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration, or if allowed by State and Local authorities, by burning. If burned, stay out of smoke.
General: Consult federal, state, or local disposal authorities for approved alternative procedures.

Warranty Disclaimer

SePRO Corporation warrants that the product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. SEPRO CORPORATION MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.

Inherent Risks Of Use

It is impossible to eliminate all risks associated with use of this product. Plant injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label such as unfavorable temperatures, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner or application, or other factors, all of which are beyond the control of SePRO Corporation as the seller. 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 SePRO Corporation's election, one of the following:

1. Refund of purchase price paid by buyer or user for product bought, or
2. Replacement of amount of product used.

SePRO Corporation shall not be liable for losses or damages resulting from handling or use of this product unless SePRO Corporation is promptly notified of such losses or damages in writing. In no case shall SePRO Corporation be liable for consequential or incidental damages or losses.

The terms of the Warranty Disclaimer above and this Limitation of Remedies can not be varied by any written or verbal statements or agreements. No employee or sales agent of SePRO Corporation or the seller is authorized to vary or exceed the terms of the Warranty Disclaimer or Limitations of Remedies in any manner.

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Specimen Label

Sonar* SRP

Aquatic Herbicide

An herbicide for management of aquatic vegetation in fresh water ponds, lakes, reservoirs, potable water sources, drainage canals, irrigation canals and rivers.

Active Ingredient:
Fluridone:
1-methyl-3-phenyl-5-[3-(trifluoromethyl)phenyl]
-4(1*H*)-pyridinone 5.0%
Other Ingredients 95.0%
TOTAL 100.0%
Contains 0.05 pounds active ingredient per pound.

Keep Out of Reach of Children

CAUTION / PRECAUCIÓN

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

Precautionary Statements

Hazards to Humans and Domestic Animals

Harmful if Swallowed, Absorbed Through Skin, or if Inhaled

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

ENVIRONMENTAL HAZARDS

Follow use directions carefully so as to minimize adverse effects on non-target organisms. In order to avoid impact on threatened or endangered aquatic plant or animal species, users must consult their State Fish and Game Agency or the U.S. Fish and Wildlife Service before making applications.

Trees and shrubs growing in water treated with Sonar SRP may occasionally develop chlorosis. Do not apply in tidewater/brackish water.

Lowest rates should be used in shallow areas where the water depth is considerably less than the average depth of the entire treatment site, for example, shallow shoreline areas.

First Aid	
If in eyes	• Hold eye open and rinse slowly and gently with water for 15 - 20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15 - 20 minutes. • Call a poison control center or doctor for treatment advice.
If swallowed	• Call a poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by a poison control center or doctor. • Do not give anything by mouth to an unconscious person.
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.

EMERGENCY NUMBER
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. In case of emergency endangering health or the environment involving this product, call **INFOTRAC** at **1-800-535-5053**.

Refer to inside of label booklet for additional precautionary information and Directions for Use including Storage and Disposal.

Notice: Read the entire label before using. Use only according to label directions. **Before buying or using this product, read "Warranty Disclaimer," "Inherent Risks of Use," and "Limitation of Remedies" inside label booklet.**

For product information, visit our web site at **www.sepro.com**.

EPA Reg. No. 67690-3
FPL 060206

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SePRO Corporation Carmel, IN 46032 U.S.A.

Directions for Use

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

Read all Directions Carefully Before Applying Sonar SRP.

GENERAL INSTRUCTIONS

Sonar SRP herbicide is a selective systemic aquatic herbicide for management of aquatic vegetation in fresh water ponds, lakes, reservoirs, drainage canals, irrigation canals, and rivers. Sonar SRP is a pelleted formulation containing 5% fluridone. Sonar is absorbed from water by plant shoots and from hydrosoil by the roots of aquatic vascular plants. It is important to maintain Sonar in contact with the target plants for as long as possible. Rapid water movement or any condition which results in rapid dilution of Sonar in treated water will reduce its effectiveness. In susceptible plants, Sonar inhibits the formation of carotene. In the absence of carotene, chlorophyll is rapidly degraded by sunlight. Herbicidal symptoms of Sonar appear in seven to ten days and appear as white (chlorotic) or pink growing points. Under optimum conditions 30 to 90 days are required before the desired level of aquatic weed management is achieved with Sonar. Species susceptibility to Sonar SRP may vary depending on time of year, stage of growth and water movement. For best results, apply Sonar SRP prior to initiation of weed growth or when weeds begin active growth. Application to mature target plants may require higher application rates and may take longer to control.

Sonar SRP is not corrosive to application equipment.

The label provides recommendations on the use of a chemical analysis for the active ingredient. SePRO Corporation recommends the use of an Enzyme-Linked Immunoassay (ELISA Test) for the determination of the active ingredient concentration in the water. Contact SePRO Corporation to incorporate this test, known as a FasTEST*, into your treatment program. Other proven chemical analyses for the active ingredient may also be used. The chemical analysis, FasTEST, is referenced in this label as the preferred method for the rapid determination of the concentration of the active ingredient in the water.

Application rates are provided in pounds of Sonar SRP to achieve a desired concentration of the active ingredient in part per billion (ppb). The maximum application rate or sum of all application rates is 90 ppb in ponds and 150 ppb in lakes and reservoirs per annual growth cycle. This maximum concentration is the amount of product calculated as the target application rate, NOT determined by testing the residues of the active ingredient in the treated water.

GENERAL USE PRECAUTIONS

- **Obtain required permits:** Consult with appropriate state or local water authorities before applying this product. Permits may be required by state or local public agencies.

- **NEW YORK STATE:** Application of Sonar SRP is not permitted in waters less than two (2) feet deep.

- **Hydroponic Farming:** Do not use Sonar SRP treated water for hydroponic farming.

- **Greenhouse and Nursery Plants:** Do not use Sonar SRP treated water for irrigating greenhouse or nursery plants. Use of an approved assay should confirm that residues are <1 ppb.

WATER USE RESTRICTIONS FOLLOWING APPLICATIONS WITH SONAR SRP (DAYS)

Application Rate	Drinking†	Fishing	Swimming	Livestock/Pet Consumption	Irrigation††
Maximum Rate (150 ppb) or less	0	0	0	0	See irrigation instructions below

† Note below, under Potable Water Intakes, the information for application of Sonar SRP within 1/4 miles (1,320 feet) of a functioning potable water intake.

†† Note below, under Irrigation, specific time frames or fluridone residues that provide the widest safety margin for irrigating with fluridone treated water.

- **Potable Water Intakes:** Concentrations of the active ingredient fluridone up to 150 ppb are allowed in potable water sources; however, in lakes and reservoirs or other sources of potable water, DO NOT APPLY Sonar SRP at application rates greater than 20 ppb within one-fourth mile (1,320 feet) of any functioning potable water intake. At application rates of 8 - 20 ppb, Sonar SRP MAY BE APPLIED where functioning potable water intakes are present. **Note: Existing potable water intakes which are no longer in use, such as those replaced by connections to potable water wells or a municipal water system, are not considered to be functioning potable water intakes.**

- **Irrigation:** Irrigation with Sonar SRP treated water may result in injury to the irrigated vegetation. SePRO Corporation recommends following these precautions and informing those who irrigate from areas treated with Sonar SRP of the irrigation time frames or water assay requirements presented in the table below. These time frames and assay recommendations are suggestions which should be followed to reduce the potential for injury to vegetation irrigated with water treated with Sonar SRP. Greater potential for crop injury occurs where Sonar SRP treated water is applied to crops grown on low organic and sandy soils.

Days After Application

Application Site	Established Tree Crops	Established Row Crops/ Turf/Plants	Newly Seeded Crops/Seedbeds or Areas to be Planted Including Overseeded Golf Course Greens
†Ponds and Static Canals	7	30	Assay required
Canals	7	7	Assay required
Rivers	7	7	Assay required
††Lakes and Reservoirs	7	7	Assay required

† For purposes of Sonar SRP labeling, a pond is defined as a body of water 10 acres or less in size. A lake or reservoir is greater than 10 acres.

†† In lakes and reservoirs where one-half or greater of the body of water is treated, use the pond and static canal irrigation precautions.

Where the use of Sonar SRP treated water is desired for irrigating crops prior to the time frames established above, the use of FasTEST assay is recommended to measure the concentration in the treated water. Where FasTEST has determined that concentrations are less than 10 parts per billion, there are no irrigation precautions for irrigating established tree crops, established row crops or turf. **For tobacco, tomatoes, peppers or other plants within the Solanaceae Family and newly seeded crops or newly seeded grasses such as overseeded golf course greens, do not use Sonar SRP treated water if concentration are greater than 5 ppb; furthermore, when rotating crops, do not plant members of the Solanaceae family in land that has been previously irrigated with fluridone concentrations in excess of 5 ppb. It is recommended that an aquatic specialist be consulted prior to commencing irrigation of these sites.**

PLANT CONTROL INFORMATION

Sonar SRP selectivity is dependent upon dosage, time of year, stage of growth, method of application, and water movement. The following categories, controlled, partially controlled, and not controlled are provided to describe expected efficacy under ideal treatment conditions using higher to maximum label rates. Use of lower rates will increase selectivity of some species listed as controlled or partially controlled. Additional aquatic plants may be controlled, partially controlled, or tolerant to Sonar SRP. Consult an aquatic specialist prior to application of Sonar SRP to determine a plant's susceptibility to Sonar SRP.

VASCULAR AQUATIC PLANTS CONTROLLED BY SONAR SRP†

Submersed Plants:

Bladderwort (*Utricularia* spp.)
Common coontail (*Ceratophyllum demersum*)†
Common Elodea (*Elodea canadensis*)†
Egeria, Brazilian Elodea (*Egeria densa*)
Fanwort, Cabomba (*Cabomba caroliniana*)
Hydrilla (*Hydrilla verticillata*)
Naiad (*Najas* spp.)†
Pondweed (*Potamogeton* spp., except Illinois pondweed)†
Watermilfoil (*Myriophyllum* spp. except variable-leaf milfoil)

Shoreline Grasses:

Paragrass (*Urochloa mutica*)

†Species denoted are native plants that are often tolerant to Sonar at lower use rates. Please consult an aquatic specialist for recommended Sonar SRP use rates when selective control of exotic species is desired.

VASCULAR AQUATIC PLANTS PARTIALLY CONTROLLED BY SONAR Q

Floating Plants:

Salvinia (*Salvinia* spp.)

Emersed Plants:

Alligatorweed (*Alternanthera philoxeroides*)
American lotus (*Nelumbo lutea*)
Cattail (*Typha* spp.)
Creeping waterprimrose (*Ludwigia peploides*)
Parrotfeather (*Myriophyllum aquaticum*)
Smartweed (*Polygonum* spp.)
Spatterdock (*Nuphar luteum*)
Spikerush (*Eleocharis* spp.)
Waterlily (*Nymphaea* spp.)
Waterpurslane (*Ludwigia palustris*)
Watershield (*Brasenia schreberi*)

Submersed Plants:

Illinois pondweed (*Potamogeton illinoensis*)
Limnophila (*Limnophila sessiliflora*)
Tapegrass, American eelgrass (*Vallisneria americana*)
Watermilfoil–variable-leaf (*Myriophyllum heterophyllum*)

Shoreline Grasses:

Barnyardgrass (*Echinochloa crusgalli*)
Giant cutgrass (*Zizaniopsis miliacea*)
Reed canarygrass (*Philaris arundinaceae*)
Southern watergrass (*Hydrochloa caroliniensis*)
Torpedograss (*Panicum repens*)

VASCULAR AQUATIC PLANTS NOT CONTROLLED BY SONAR SRP

Floating Plants:

Floating waterhyacinth (*Eichhornia crassipes*)
Waterlettuce (*Pistia stratiotes*)

Emersed Plants:

American frogbit (*Limnobium spongia*)
Arrowhead (*Sagittaria* spp.)
Bacopa (*Bacopa* spp.)
Big floatingheart, banana lily (*Nymphoides aquatica*)
Bulrush (*Scirpus* spp.)
Pickerelweed, lanceleaf (*Pontederia* spp.)
Rush (*Juncus* spp.)
Water pennywort (*Hydrocotyle* spp.)

Shoreline Grasses:

Maidencane (*Panicum hemitomon*)

NOTE: Algae (chara, nitella, and filamentous species are not controlled by Sonar SRP).

APPLICATION DIRECTIONS

The aquatic plants present in the treatment site should be identified prior to application to determine their susceptibility to Sonar SRP. It is important to determine the area (acres) to be treated and the average depth in order to select the proper application rate. Do not exceed the maximum labeled rate for a given treatment site per annual growth cycle.

Application to Ponds

Sonar SRP may be applied to the entire surface area of a pond. For single applications, rates may be selected to provide 45 to 90 ppb to the treated water, although actual concentrations in treated water may be substantially lower at any point in time due to the slow-release formulation of this product. When treating for optimum selective control, lower rates may be applied for sensitive target species. Use the higher rate within the rate range where there is a dense weed mass, when treating more difficult to control species, and for ponds less than 5 acres in size with an average depth less than 4 feet. Application rates necessary to obtain these concentrations in treated water are shown in the following table. For additional application rate calculations, refer to *Application Rate Calculations – Ponds, Lakes and Reservoirs*. Split or multiple applications are recommended where dilution of treated water is anticipated; however, the sum of all applications should total 45 to 90 ppb and must not exceed a total of 90 ppb per annual growth cycle.

Application to Lakes and Reservoirs

The following treatments are recommended for treating both whole lakes or reservoirs and partial areas of lakes or reservoirs (bays, etc.). For best results in treating partial lakes and reservoirs, Sonar SRP treatment areas should be a minimum of 5 acres in size. Treatment of areas smaller than 5 acres or treatment of narrow strips such as boat lanes or shorelines may not produce satisfactory results due to dilution by untreated water. Rate ranges are provided as a guide to include a wide range of environmental factors, such as target species, plant susceptibility, selectivity and other aquatic plant management objectives. Application rates and methods should be selected to meet the specific lake/reservoir aquatic plant management goals.

Application Rates

Average Water Depth of Treatment Site (feet)	Pounds of Sonar SRP per treated surface acre 45 ppb to 90 ppb	
1	2.5	5
2	5	10
3	7.5	15
4	10	20
5	12.5	25
6	15	30
7	17	34
8	19.5	39
9	22	44
10	24.5	49

A. Whole Lake or Reservoir Treatments (Limited or No Water Discharge)

1. Single Application to Whole Lakes or Reservoirs

Where single applications to whole lakes or reservoirs are desired, apply Sonar SRP at an application rate of 16 to 90 ppb. Application rates necessary to obtain these concentrations in treated water are shown in the following table. For additional rate calculations, refer to *Application Rate Calculation-Ponds, Lakes and Reservoirs*. Choose an application rate to meet the aquatic plant management objective. **Where greater plant selectivity is desired such as when controlling Eurasian watermilfoil and curlyleaf pondweed, choose an application rate lower in the rate range.** For other plant species, SePRO recommends contacting an aquatic specialist in determining when to choose application rates lower in the rate range to meet specific plant management goals. Use the higher rate within the rate range where there is a dense weed mass or when treating more difficult to control plant species or in the event of a heavy rainfall event where dilution has occurred. In these cases, a second application or more may be required; however, the sum of all applications cannot exceed 150 ppb per annual growth cycle. Refer to the following Section (No. 2) *Split or Multiple Applications* for guidelines and maximum rate allowed.

Application Rates

Average Water Depth of Treatment Site (feet)	Pounds of Sonar SRP per treated surface acre 16 ppb to 90 ppb	
1	0.9	5
2	1.7	10
3	2.6	15
4	3.5	20
5	4.3	25
6	5.2	30
7	6.0	34
8	6.9	39
9	7.8	44
10	8.6	49
11	9.5	54
12	10.4	59
13	11.2	64
14	12.1	68
15	13.0	73
16	13.8	78
17	14.7	83
18	15.6	88
19	16.4	93
20	17.3	98

2. Split or Multiple Applications to Whole Lakes or Reservoirs

To meet certain plant management objectives, split or multiple applications may be desired in making whole lake treatments. Split or multiple application programs are desirable when the objective is to use the minimum effective dose and to maintain this lower dose for the sufficient time to ensure efficacy and enhance selectivity. Under these situations, use the lower rates (16 to 75 ppb) within the rate range. In controlling Eurasian watermilfoil and curlyleaf pondweed and where greater plant selectivity is desired, choose an application rate lower in the rate range. For other plant species, SePRO recommends contacting an aquatic specialist in determining when to choose application rates lower in the rate range to meet specific plant management goals. For split or repeated applications, the sum of all applications must not exceed 150 ppb per annual growth cycle.

NOTE: In treating lakes or reservoirs that contain potable water intakes and the application requires treating within 1/4 mile of a potable water intake, no single application can exceed 20 ppb. Additionally, the sum of all applications cannot exceed 150 ppb per annual growth cycle.

B. Partial Lake or Reservoir Treatments

Where dilution of Sonar SRP with untreated water is anticipated, such as in partial lake or reservoir treatments, split or multiple applications may be used to extend the contact time to the target plants. The application rate and use frequency of Sonar SRP in a partial lake is highly dependent upon the treatment area. Higher application rates may be required and frequency of applications will vary depending upon the potential of untreated water diluting the Sonar SRP concentration in the treatment area. Use higher rates where greater dilution with untreated water is anticipated.

1. Application Sites Greater Than 1/4 Mile from a Functioning Potable Water Intake

For single applications, apply Sonar SRP at application rates from 45 to150 ppb. Split or multiple applications may be made, however, the sum of all applications cannot exceed 150 ppb per annual growth cycle. Split applications should be conducted to maintain a sufficient concentration in the target area for a period of 45 days or longer. The use of FasTEST is recommended to maintain the desired concentration in the target area over time.

2. Application Sites Within 1/4 Mile of a Functioning Potable Water Intake

In treatment areas that are within 1/4 mile of a potable water intake, no single application can exceed 20 ppb. When utilizing split or repeated applications of Sonar SRP for sites which contain a potable water intake, FasTEST is required to determine the actual concentration in the water. Additionally, the sum of all applications cannot exceed 150 ppb per annual growth cycle.

APPLICATION RATE CALCULATION - PONDS, LAKES AND RESERVOIRS

The amount of Sonar SRP to be applied to provide the desired ppb concentration of active ingredient equivalents in treated water may be calculated as follows:

- Pounds of Sonar SRP required per treated acre = Average water depth of treatment site x Desired ppb concentration of active ingredient equivalents x 0.054

For example, the pounds per acre of Sonar SRP required to provide a concentration of 25 ppb of active ingredient equivalents in water with an average depth of 5 feet is calculated as follows:

5 x 25 x 0.054 = 0.33 6.75 pounds per treated surface acre.

NOTE: Calculated rates should not exceed the maximum allowable rate in pounds per treated surface acre for the water depth listed in the application rate table for the site to be treated.

APPLICATION TO DRAINAGE CANALS, IRRIGATION CANALS AND RIVERS

Static Canals: In static drainage and irrigation canals, Sonar SRP should be applied at the rate of 20 to 40 pounds per surface acre.

Moving Water Canals and Rivers: The performance of Sonar SRP will be enhanced by restricting or reducing water flow. In slow moving bodies of water use an application technique that maintains a concentration of 10 to 40 ppb in the applied area for a minimum of 45 days. Sonar SRP can be applied by split or multiple broadcast applications or by metering in the product to provide a uniform concentration of the herbicide based upon the flow pattern. The use of FasTEST is recommended to maintain the desired concentration in the target area over time.

Static or Moving Water Canals or Rivers Containing a Functioning Potable Water Intake: In treating a static or moving water canal or river which contains a functioning potable water intake, applications of Sonar SRP greater than 20 ppb must be made more than 1/4 mile from a functioning potable water intake. Applications less than 20 ppb may be applied within 1/4 mile from a functioning potable water intake; however, if applications of Sonar SRP are made within 1/4 mile from a functioning water intake, the FasTEST must be utilized to demonstrate that concentrations do not exceed 150 ppb at the potable water intake.

APPLICATION RATE CALCULATION – DRAINAGE CANALS, IRRIGATION CANALS AND RIVERS

The amount of Sonar SRP to be applied through a metering system to provide the desired ppb concentration of active ingredient in treated water may be calculated as follows:

1. Average flow rate (feet per second) x average width (ft.) x average depth (ft.) x 0.9 = CFS (cubic feet per second)

2. CFS x 1.98 = acre feet per day (water movement)

3. Acre feet per day x desired ppb x 0.054 = pounds Sonar SRP required per day

Storage and Disposal

Do not contaminate water, food or feed by storage or disposal.

Pesticide Storage: Store in original container only. Do not store near feed or foodstuffs. In case of leak or spill, contain material and dispose as waste.

Pesticide Disposal: Wastes resulting from use of this product may be used according to label directions or disposed of at an approved waste disposal facility.

Container Disposal: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration, or if allowed by State and Local authorities, by burning. If burned, stay out of smoke.

Container Disposal for Refillable Containers: Seal all openings which have been opened during use. Return the empty container to a collection site designated by SePRO Corporation. If the container has been damaged and cannot be returned according to the recommended procedures, contact SePRO Corporation at 1-800-419-7779 to obtain proper handling instructions.

General: Consult federal, state, or local disposal authorities for approved alternative procedures.

Warranty Disclaimer

SePRO Corporation warrants that the product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. SEPRO CORPORATION MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.

Inherent Risks of Use

It is impossible to eliminate all risks associated with use of this product. Plant injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label such as unfavorable temperatures, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner or application, or other factors, all of which are beyond the control of SePRO Corporation as the seller. 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 SePRO Corporation's election, one of the following:

1. Refund of purchase price paid by buyer or user for product bought, or
2. Replacement of amount of product used.

SePRO Corporation shall not be liable for losses or damages resulting from handling or use of this product unless SePRO Corporation is promptly notified of such losses or damages in writing. In no case shall SePRO Corporation be liable for consequential or incidental damages or losses.

The terms of the "Warranty Disclaimer" above and this "Limitation of Remedies" can not be varied by any written or verbal statements or agreements. No employee or sales agent of SePRO Corporation or the seller is authorized to vary or exceed the terms of the "Warranty Disclaimer" or "Limitations of Remedies" in any manner.

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PULL HERE TO OPEN

Reward®

Landscape and Aquatic Herbicide

TO PREVENT ACCIDENTAL POISONING, NEVER PUT INTO FOOD, DRINK, OR OTHER CONTAINERS, AND USE STRICTLY IN ACCORDANCE WITH ENTIRE LABEL.

DO NOT USE THIS PRODUCT FOR REFORMULATION.

Active Ingredient:	
Diquat dibromide [6,7-dihydrodipyrido (1,2-a:2′,1′-c) pyrazinediium dibromide]	37.3%
Other Ingredients:	62.7%
Total:	100.0%

Contains 2 lbs. diquat cation per gal. (3.73 lbs. diquat dibromide per gal.)

KEEP OUT OF REACH OF CHILDREN.

CAUTION

See additional precautionary statements on label.

EPA Reg. No. 100-1091
EPA Est. 100-LA-001

Product of United Kingdom
Formulated in the USA

SCP 1091A-L2E 0508
264067

2.5 gallons
Net Contents

syngenta®

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.
If swallowed	• Call a poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by the poison control center or doctor. • Do not give anything by mouth to an unconscious person.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor for treatment advice.

NOTE TO PHYSICIANS

To be effective, treatment for diquat poisoning must begin **IMMEDIATELY**. Treatment consists of binding diquat in the gut with suspensions of activated charcoal or bentonite clay, administration of cathartics to enhance elimination, and removal of diquat from the blood by charcoal hemoperfusion or continuous hemodialysis.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment.

HOTLINE NUMBER

For 24-Hour Medical Emergency Assistance (Human or Animal) or Chemical Emergency Assistance (Spill, Leak, Fire, or Accident), Call

1-800-888-8372

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

CAUTION

Harmful if inhaled. Harmful if swallowed. Causes moderate eye irritation. Avoid breathing spray mist. Avoid contact with eyes, skin, or clothing.

continued...

PRECAUTIONARY STATEMENTS *(continued)*

Personal Protective Equipment (PPE)

Some materials that are chemical-resistant to this product are: barrier laminate, butyl rubber ≥14 mils, nitrile rubber ≥14 mils. If you want more options, follow the instructions for Category A on an EPA Chemical Resistance Category Selection Chart.

Mixers, Loaders, Applicators and other handlers must wear:

- Coveralls over short-sleeved shirt and short pants or coveralls over long-sleeved shirt and long pants
- Chemical-resistant gloves
- Chemical-resistant footwear plus socks
- Protective eyewear
- Chemical-resistant headgear for overhead exposure
- Chemical-resistant apron when cleaning equipment, mixing, or loading
- Face shield when mixing or loading

Exception: After this product has been diluted to 0.50% Reward or less in water (i.e., the labeled rate for some spot applications), applicators for AQUATIC SURFACE APPLICATIONS must, at a minimum, wear (Note - Mixers and Loaders for this application method must still wear the personal protective equipment (PPE) as described in the above section):

- Long-sleeved shirt and long pants
- Shoes plus socks
- Waterproof gloves
- Protective eyewear

Exception: At a minimum, applicators for AQUATIC SUBSURFACE APPLICATIONS must wear (Note - Mixers and Loaders for this application method must still wear the personal protective equipment (PPE) as described in the above section):

- Short-sleeved shirt and short pants
- Waterproof gloves
- Chemical-resistant footwear plus socks

Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them. Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

Engineering Control Statements

Mixers and loaders supporting aerial applications are required to use closed systems that provide dermal protection. The closed system must be used in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240(d)(4)]. When using the closed system, mixers and loaders PPE requirements may be reduced or modified as specified in the WPS.

When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240(d)(4-6)], the handler PPE requirements may be reduced or modified as specified in the WPS.

User Safety Recommendations

Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
- Remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. Prolonged contact of the product with the skin may produce burns.
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

Environmental Hazards

This pesticide is toxic to aquatic invertebrates. **For Terrestrial Uses,** do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment wash water. **For Aquatic Uses** do not apply directly to water except as specified on this label.

CONDITIONS OF SALE AND LIMITATION OF WARRANTY AND LIABILITY

NOTICE: Read the entire Directions for Use and Conditions of Sale and Limitation of Warranty and Liability before buying or using this product. If the terms are not acceptable, return the product at once, unopened, and the purchase price will be refunded.

The Directions for Use of this product must be followed carefully. It is impossible to eliminate all risks inherently associated with the use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as manner of use or application, weather or crop conditions, presence of other materials or other influencing factors in the use of the product, which are beyond the control of SYNGENTA CROP PROTECTION, Inc. or Seller. To the extent permitted by applicable law, Buyer and User agree to hold SYNGENTA and Seller harmless for any claims relating to such factors.

SYNGENTA warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated in the Directions for Use, subject to the inherent risks referred to above, when used in accordance with directions under normal use conditions. To the extent permitted by applicable law: (1) this warranty does not extend to the use of the product contrary to label instructions or under conditions not reasonably foreseeable to or beyond the control of Seller or SYNGENTA, and, (2) Buyer and User assume the risk of any such use. To the extent permitted by applicable law, SYNGENTA MAKES NO WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE NOR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS WARRANTED BY THIS LABEL.

To the extent permitted by applicable law, in no event shall SYNGENTA be liable for any incidental, consequential or special damages resulting from the use or handling of this product. **TO THE EXTENT PERMITTED BY APPLICABLE LAW, THE EXCLUSIVE REMEDY OF THE USER OR BUYER, AND THE EXCLUSIVE LIABILITY OF SYNGENTA AND SELLER FOR ANY AND ALL CLAIMS, LOSSES, INJURIES OR DAMAGES (INCLUDING CLAIMS BASED ON BREACH OF WARRANTY, CONTRACT, NEGLIGENCE, TORT, STRICT LIABILITY OR OTHERWISE) RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT, SHALL BE THE RETURN OF THE PURCHASE PRICE OF THE PRODUCT OR, AT THE ELECTION OF SYNGENTA OR SELLER, THE REPLACEMENT OF THE PRODUCT.**

SYNGENTA and Seller offer this product, and Buyer and User accept it, subject to the foregoing Conditions of Sale and Limitation of Warranty and Liability, which may not be modified except by written agreement signed by a duly authorized representative of SYNGENTA.

DIRECTIONS FOR USE

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

READ ENTIRE LABEL. USE STRICTLY IN ACCORDANCE WITH PRECAUTIONARY STATEMENTS AND DIRECTIONS, AND WITH APPLICABLE STATE AND FEDERAL REGULATIONS.

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

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 24 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 over short-sleeved shirt and short pants, or coveralls over long-sleeved shirt and long pants
- Chemical-resistant gloves made of any waterproof material
- Chemical-resistant footwear plus socks
- Protective eyewear
- Chemical-resistant headgear for overhead exposure

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 all unprotected persons out of operating areas or vicinity where there may be drift.

For terrestrial uses, do not enter or allow entry of maintenance workers into treated areas, or allow contact with treated vegetation wet with spray, dew, or rain, without appropriate protective clothing until spray has dried.

For aquatic uses, do not enter treated areas while treatments are in progress.

SPECIFIC USE DIRECTIONS

Reward Landscape and Aquatic Herbicide is a nonvolatile herbicidal chemical for use as a general herbicide to control weeds in commercial greenhouses and nurseries; ornamental seed crops (flowers, bulbs, etc. – except in the state of California); landscape, industrial, recreational, commercial, residential, and public areas; turf renovation (all turf areas except commercial sod farms); dormant established turfgrass (bermudagrass, zoysiagrass – nonfood or feed crop); and aquatic areas. Absorption and herbicidal action is usually quite rapid with effects visible in a few days. Reward Landscape and Aquatic Herbicide controls weeds by interfering with photosynthesis within green plant tissue. Weed plants should be succulent and actively growing for best results. Rinse all spray equipment thoroughly with water after use. Avoid spray drift to crops, ornamentals, and other desirable plants during application, as injury may result. Application to muddy water may result in reduced control. Minimize creating muddy water during application. Use of dirty or muddy water for Reward Landscape and Aquatic Herbicide dilution may result in reduced herbicidal activity. Avoid applying under conditions of high wind, water flow, or wave action.

SPRAY DRIFT MANAGEMENT

Avoiding spray drift at the application site is the responsibility of the applicator and the grower. 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 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.

- The distance of the outermost nozzles on the boom must not exceed 3/4 the length of the wingspan or rotor.
- Nozzles must always point backward parallel with the air stream and never be pointed downward more than 45 degrees.

Where states have more stringent regulations, they should be observed.

Droplet Size

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

Controlling Droplet Size

- **Volume** – Use high flow rate nozzles to apply the highest practical spray volume. Nozzles with higher rated flows produce larger droplets.
- **Pressure** – Do not exceed the nozzle manufacturer's recommended pressures. For many nozzle types, lower pressure produces larger droplets. When higher flow rates are needed, use higher flow rate nozzles instead of increasing pressure.
- **Number of Nozzles** – Use the minimum number of nozzles that provide uniform coverage.
- **Nozzle Orientation** – Orienting nozzles so that the spray is released parallel to the airstream produces larger droplets than other orientations and is the recommended practice. Significant deflection from horizontal will reduce droplet size and increase drift potential.
- **Nozzle Type** – Use a nozzle type that is designed for the intended application. With most nozzle types, narrower spray angles produce larger droplets. Consider using low-drift nozzles. Solid stream nozzles oriented straight back produce the largest droplets and the lowest drift.

Boom Length

For some use patterns, reducing the effective boom length to less than 3/4 of the wingspan or rotor length may further reduce drift without reducing swath width.

Application Height

Applications should not be made at a height greater than 10 ft. above the top of the target 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 spray drift.

Temperature and Humidity

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

Temperature Inversions

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

Sensitive Areas

The pesticide should only be applied when the wind is blowing away from adjacent sensitive areas (e.g., residential areas, bodies of water, known habitat for threatened or endangered species, nontarget crops).

COMMERCIAL GREENHOUSES AND NURSERIES

For general weed control in commercial greenhouses (beneath benches), field grown and container stock, and other similar areas, Reward Landscape and Aquatic Herbicide may be applied preplant or postplant preemergence in field grown ornamental nursery plantings or postemergence as a directed spray. Reward Landscape and Aquatic Herbicide may also be applied preemergence in ornamental seed crops (except in the state of California). Avoid contact with desirable foliage as injury may occur. Do not use on food or feed crops.

Spot spray: 1-2 qts. Reward Landscape and Aquatic Herbicide plus the labeled rate of a 75% or greater nonionic surfactant per 100 gals. of water, or 0.75 oz. (22 mls.) Reward Landscape and Aquatic Herbicide plus the labeled rate of a 75% or greater nonionic surfactant per 1 gal. of water.

Broadcast: 1-2 pts. Reward Landscape and Aquatic Herbicide in a minimum of 15 gals. of water per acre. Add the labeled rate of a 75% or greater nonionic surfactant per 100 gals. of spray mixture. Use an adequate spray volume to insure good coverage.

ORNAMENTAL SEED CROPS (FLOWERS, BULBS, ETC.) EXCEPT IN THE STATE OF CALIFORNIA

For preharvest desiccation of ornamental seed crops. NOT FOR FOOD OR FIBER CROPS.

Broadcast (Air or Ground): 1.5-2 pts. Reward Landscape and Aquatic Herbicide plus the labeled rate of a 75% or greater nonionic surfactant per acre in sufficient water (minimum of 5 gals. by air; 15 gals. by ground) for desiccation and weed burndown. Repeat as needed at no less than 5-day intervals up to three applications. Do not use seed, screenings, or waste as feed or for consumption.

DIRECTIONS FOR LANDSCAPE, INDUSTRIAL, RECREATIONAL, COMMERCIAL, RESIDENTIAL, AND PUBLIC AREAS

Reward Landscape and Aquatic Herbicide provides fast control of broadleaf and grassy weeds in industrial, recreational, golf course, commercial, residential, and public areas.

Reward Landscape and Aquatic Herbicide is a nonselective herbicide that rapidly kills undesirable above ground weed growth in 24-36 hours. Avoid application of Reward Landscape and Aquatic Herbicide to desirable plants.

Reward Landscape and Aquatic Herbicide is a contact/desiccant herbicide; it is essential to obtain complete coverage of the target weeds to get good control. Improper application technique and/or application to stressed weeds may result in unacceptable weed control. For best results, apply to actively growing, young weeds.

Difficult weeds (such as perennial or deeply-rooted weeds) can often be controlled by tank mixing Reward Landscape and Aquatic Herbicide with other systemic-type herbicides. Refer to other product labels for specific application directions.

For residual weed control, tank mix Reward Landscape and Aquatic Herbicide with a preemergent herbicide labeled for the intended use site. When mixing Reward Landscape and Aquatic Herbicide with another herbicide, it is recommended to mix just a small amount first to determine if the mixture is physically compatible before proceeding with larger volumes.

Syngenta has not tested all possible tank mixtures with other herbicides for compatibility, efficacy or other adverse effects. Before mixing with other herbicides Syngenta recommends you first consult your state experimental station, state university or extension agent.

Grounds maintenance weed control: Reward Landscape and Aquatic Herbicide can be used as a spot or broadcast spray to control weeds in public, commercial and residential landscapes, including landscape beds, lawns, golf courses and roadsides. Reward Landscape and Aquatic Herbicide can also be used for weed control around the edges and nonflooded portions of ponds, lakes and ditches.

Trim and Edge weed control: Reward Landscape and Aquatic Herbicide can be used to eliminate undesired grass and broadleaf plant growth in a narrow band along driveways, walkways, patios, cart paths, fence lines, and around trees, ornamental gardens, buildings, other structures, and beneath noncommercial greenhouse benches. Vegetation control with Reward Landscape and Aquatic Herbicide is limited to the spray application width. Do not exceed the labeled rate of Reward Landscape and Aquatic Herbicide as excessive rates may result in staining of concrete-based materials.

Reward Landscape and Aquatic Herbicide, since it does not translocate systemically, can be used as an edging or pruning tool when precisely applied to select areas of grass or to undesirable growth on desirable ornamental bedding plants, ground covers, etc.

Industrial weed control: Reward Landscape and Aquatic Herbicide can be used as a spot or broadcast spray either alone or in combination with other herbicides as a fast burndown or control weeds in rights-of-ways, railroad beds/yards, highways, roads, dividers and medians, parking lots, pipelines, pumping stations, public utility lines, transformer stations and substations, electric utilities, storage yards, and other non-crop areas.

Spot spray: Apply either 1-2 qts. of Reward Landscape and Aquatic Herbicide plus the labeled rate of a 75% or greater nonionic surfactant per 100 gals. water, or 0.75 oz. (22 mls.) Reward Landscape and Aquatic Herbicide plus the labeled rate of a 75% or greater nonionic surfactant per 1 gal. of water.

Broadcast: 1-2 pts. Reward Landscape and Aquatic Herbicide per acre in sufficient water to insure good spray coverage. Add the labeled rate of 75% or greater nonionic surfactant per 100 gals. spray mixture. Greater water volumes are necessary if the target plants are tall and/or dense. It is recommended that 60 gals. or greater water volume be used to obtain good coverage of dense weeds.

TURF RENOVATION (ALL TURF AREAS EXCEPT COMMERCIAL SOD FARMS)

To desiccate golf course turf and other turf areas prior to renovation, apply 1-2 pts. of Reward Landscape and Aquatic Herbicide per acre plus the labeled rate of a 75% or greater nonionic surfactant in 20-100 gals. of water (4 teaspoons of Reward Landscape and Aquatic Herbicide plus the labeled rate of a 75% or greater nonionic surfactant per 1 gal. of water) using ground spray equipment. Apply for full coverage and thorough contact with the turfgrass. Apply only when the turf is dry, free from dew and incidental moisture. For enhanced turf desiccation, especially in the case of thick turfgrass, water volumes should approach 100 gals. of water per acre.

For **suppression** of regrowth and quick desiccation of treated turfgrass, Reward Landscape and Aquatic Herbicide may be mixed with other systemic nonselective or systemic postemergence grassy weed herbicides. Refer to other product labels for specific application directions and restrictions.

Avoid spray contact with, or spray drift to, foliage of ornamental plants or food crops.

Do not graze livestock on treated turf or feed treated thatch to livestock.

DORMANT ESTABLISHED TURFGRASS (BERMUDAGRASS, ZOYSIAGRASS), NONFOOD OR FEED CROP

For control of emerged annual broadleaf and grass weeds, including Little Barley*****, Annual Bluegrass, Bromes including Rescuegrass, Sixweeks fescue, Henbit, Buttercup, and Carolina Geranium in established dormant bermudagrass lawns, parks, golf courses, etc.

Apply 1-2 pts. Reward Landscape and Aquatic Herbicide per acre in 20-100 gals. of spray mix by ground as a broadcast application. Add the labeled rate of a 75% or greater nonionic surfactant per 100 gals. of spray mixture.

Bermudagrass must be dormant at application. Application to actively growing bermudagrass may cause delay or permanent injury. Users in the extreme Southern areas should be attentive to the extent of dormancy at the time of application.

*****For control of Little Barley, apply Reward Landscape and Aquatic Herbicide prior to the mid-boot stage.

AQUATIC USE DIRECTIONS

New York – Not for Sale or Use in New York State without Supplemental Special Local Needs Labeling.

Necessary approval and/or permits must be obtained prior to application if required. Consult the responsible State Agencies (i.e., Fish and Game Agencies, State Water Conservation authorities, or Department of Natural Resources).

Treatment of dense weed areas may result in oxygen loss from decomposition of dead weeds. This loss of oxygen may cause fish suffocation. Therefore, treat only 1/3 to 1/2 of the water body area at one time and wait 14 days between treatments.

For best results on submersed weeds, Reward Landscape and Aquatic Herbicide should be applied to actively growing (photosynthesizing) weeds when water temperatures have reached or exceeded approximately 50°F, typically during the Spring or early Summer.

For application only to **still water** (i.e. ponds, lakes, and drainage ditches) where there is minimal or no outflow to public waters.

and/or

For applications to **public waters** in ponds, lakes, reservoirs, marshes, bayous, drainage ditches, canals, streams, rivers, and other slow-moving or quiescent bodies of water for control of aquatic weeds. For use by:

- Corps of Engineers; or
- Federal or State Public Agencies (i.e., Water Management District personnel, municipal officials); or
- Applicators and/or Licensees (certified for aquatic pest control) that are authorized by the State or Local government.

Treated water may be used according to the following table or until such time as an approved assay (example: PAM II Spectromatic Method) shows that the water does not contain more than the designated maximum contaminant level goal (MCLG) of 0.02 mg/l. (ppm) of diquat dibromide (calculated as the cation).

Water Use Restrictions Following Applications With Reward Landscape And Aquatic Herbicide (Days)

Application Rate	Drinking	Fishing and Swimming	Livestock/ Domestic Animals Consumption	Spray Tank Applications** and Irrigation to Turf and Landscape Ornamentals	Spray Tank Applications** and Irrigation to Food Crops and Production Ornamentals
2 gals./surface acre	3 days	0	1 day	3 days	5 days
1 gal./surface acre	2 days	0	1 day	2 days	5 days
0.75 gal./surface acre	2 days	0	1 day	2 days	5 days
0.50 gal./surface acre	1 day	0	1 day	1 day	5 days
Spot Spray* (< 0.5 gal./surface acre)	1 day	0	1 day	1 day	5 days

***Add a nonionic surfactant (with at least 75% of the constituents active as a spray adjuvant) at the rate recommended by the manufacturer.

****For preparing agricultural sprays for food crops, turf or ornamentals (to prevent phytotoxicity), do not use water treated with Reward Landscape and Aquatic Herbicide before the specified time period.

When the contents of more than one spray tank is necessary to complete a single aquatic application, no water holding restrictions apply between the consecutive spray tanks.

No applications are to be made in areas where commercial processing of fish, resulting in the production of fish protein concentrate or fish meal, is practiced. Before application, coordination and approval of local and/or State authorities must be obtained.

Floating and Marginal Weeds Including:

Water lettuce, *Pistia stratiotes*
Water hyacinth, *Eichhornia crassipes*
Duckweed, *Lemna* spp.
Salvinia spp. (including *S. molesta*)
Pennywort (*Hydrocotyle* spp.)
Frog's Bit[1], *Limnobium spongia*
Cattails, *Typha* spp.

[1]Not for use in California

Reward Landscape and Aquatic Herbicide may be applied by backpack, airboat, spray handgun, helicopter, airplane, or similar application equipment that results in thorough spray coverage.

Spot Treatment: Apply Reward Landscape and Aquatic Herbicide at 2 quarts per 100 gallons spray carrier (0.5% solution) with an approved aquatic wetting agent at 0.25-1.0% v/v (1 quart to 1 gallon per 100 gallons water). For cattail control, Reward Landscape and Aquatic Herbicide should be applied prior to flowering at the maximum application rate (8 quarts of Reward Landscape and Aquatic Herbicide/100 gallons spray carrier) plus the wetting agent. Repeat treatments may be necessary for complete control.

Spray to completely wet target weeds but not to runoff. Densely packed weeds or mats may require additional applications due to incomplete spray coverage. Re-treat as needed. For best results, re-treat weed escapes within 2 weeks of the initial treatment.

Broadcast Treatment: Apply Reward Landscape and Aquatic Herbicide at the rate of 0.5-2.0 gallons per surface acre in sufficient carrier along with 16-32 oz./A of an approved wetting agent. Re-treat as necessary for densely populated weed areas. Good coverage is necessary for control of the target weeds.

For duckweed control, apply Reward Landscape and Aquatic Herbicide at 1-2 gallons/A.

Submersed Weeds Including:

Bladderwort, *Utricularia* spp.
Hydrilla, *Hydrilla verticillata*
Watermilfoils (including Eurasian), *Myriophyllum* spp.
Pondweeds[1], *Potamogeton* spp.
Coontail, *Ceratophyllum demersum*
Elodea, *Elodea* spp.
Brazilian Elodea, *Egeria densa*
Naiad, *Najas* spp.
Algae[2], *Spirogyra* spp. and *Pithophora* spp.

[1]Reward Landscape and Aquatic Herbicide controls *Potamogetan* species except Richardson's pondweed, *P. richardsonii*.

[2]Suppression only. For control of *Spirogyra* and/or *Pithophora*, use Reward Landscape and Aquatic Herbicide in a tank mix with an approved algaecide.

For severe weed or algae infestations, the use of an approved algaecide either as a pretreatment to the Reward Landscape and Aquatic Herbicide application or in a tank mix, may result in enhanced weed control.

To control submersed weeds, apply Reward Landscape and Aquatic Herbicide in water at 0.5-2.0 gallons per surface acre (per 4 foot water depth). For severe weed infestations, use the 2.0 gallon per surface acre rate. For best results, re-treat as necessary on 14-21 day intervals. The table below shows how many gallons of Reward Landscape and Aquatic Herbicide to apply per surface acre based on water depth.

	Gallons of Reward Landscape and Aquatic Herbicide per Surface Acre Average Water Depth			
	1 Foot	**2 Feet**	**3 Feet**	**4 Feet**
1 gallon/acre rate	0.25 gal.	0.50 gal.	0.75 gal.	1.0 gal.
2 gallon/acre rate	0.50 gal.	1.0 gal.	1.5 gals.	2.0 gals.

Note: For water depths of 2 feet or less including shorelines, do not exceed 1 gallon per surface acre.

Subsurface Applications: Where the submersed weed growth, especially Hydrilla, has reached the water surface, apply either in a water carrier or an invert emulsion through boom trailing hoses carrying nozzle tips to apply the dilute spray below the water surface to insure adequate coverage.

Bottom Placement: Where submersed weeds such as Hydrilla, Bladderwort, or Coontail have reached the water surface and/or where the water is slowly moving through the weed growth, the use of an invert emulsion carrier injecting diluted Reward Landscape and Aquatic Herbicide near the bottom with weighted hoses may improve control. The addition of a copper based algaecide may improve control. If algae are present along with the submersed weeds, a pretreatment with a copper based algaecide may improve overall control.

Surface Application for Submerged Aquatic Weeds: Apply the recommended rate of Reward Landscape and Aquatic Herbicide as a spray in sufficient carrier to fully cover the target area. Applications should be made to ensure complete coverage of the weed areas. In mixed weed populations, use the high rate of application as indicated by weeds present. For dense submersed weeds or water over 2 feet deep, a surface spray is not recommended (Reward Landscape and Aquatic Herbicide should be applied subsurface in these situations.)

If posting is required by your state or tribe – consult the agency responsible for pesticide regulations for specific details.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

Pesticide Storage

Keep pesticide in original container. Do not put concentrate or dilute into food or drink containers. Do not contaminate feed, foodstuffs, or drinking water. Do not store or transport near feed or food. Store at temperatures above 32°F. For help with any spill, leak, fire, or exposure involving this material, call **1-800-888-8372**.

Pesticide Disposal

Open dumping is prohibited. Pesticide wastes are toxic. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

Container Disposal

Do not reuse container. Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or incineration, or if allowed by State and local authorities, by burning. If burned, stay out of smoke.

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For non-emergency (e.g., current product information), call Syngenta Crop Protection at 1-800-334-9481.

Manufactured for:
Syngenta Crop Protection, Inc.
P. O. Box 18300
Greensboro, North Carolina 27419-8300
www.syngenta-us.com

SCP 1091A-L2E 0508
264067

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Reward®

Landscape and Aquatic Herbicide

TO PREVENT ACCIDENTAL POISONING, NEVER PUT INTO FOOD, DRINK, OR OTHER CONTAINERS, AND USE STRICTLY IN ACCORDANCE WITH ENTIRE LABEL.

DO NOT USE THIS PRODUCT FOR REFORMULATION.

Active Ingredient:	
Diquat dibromide [6,7-dihydrodipyrido (1,2-a:2',1'-c) pyrazinediium dibromide]	37.3%
Other Ingredients:	62.7%
Total:	100.0%

Contains 2 lbs. diquat cation per gal. (3.73 lbs. diquat dibromide per gal.)

See additional precautionary statements in booklet.

AGRICULTURAL USE REQUIREMENTS

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR part 170. Refer to supplemental labeling under "Agricultural Use Requirements" in the Directions for Use section for information about this standard.

EPA Reg. No. 100-1091
EPA Est. 100-LA-001

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Product of United Kingdom
Formulated in the USA

Manufactured for:
Syngenta Crop Protection, Inc.
P. O. Box 18300
Greensboro, North Carolina 24719-8300
www.syngenta-us.com

SCP 1091A-L2E 0508
264067

2.5 gallons
Net Contents

BAR CODE # IS
(01) 0 07 02941 73710
LAST DIGIT IS CHECK DIGIT
(Barcode type: UCC/EAN 128)

KEEP OUT OF REACH OF CHILDREN.

CAUTION

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.

If swallowed: Call poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by the poison control center or doctor. Do not give anything by mouth to an unconscious person.

If in eyes: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

If on skin or clothing: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.

NOTE TO PHYSICIANS: To be effective, treatment for diquat poisoning must begin **IMMEDIATELY**. Treatment consists of binding diquat in the gut with suspensions of activated charcoal or bentonite clay, administration of cathartics to enhance elimination, and removal of diquat from the blood by charcoal hemoperfusion or continuous hemodialysis.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment.

HOT LINE NUMBER: For 24-Hour Medical Emergency Assistance (Human or Animal) or Chemical Emergency Assistance (Spill, Leak, Fire, or Accident), Call **1-800-888-8372.**

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

CAUTION

Harmful if inhaled. Harmful if swallowed. Causes moderate eye irritation. Avoid breathing spray mist. Avoid contact with eyes, skin, or clothing.

Environmental Hazards: This pesticide is toxic to aquatic invertebrates. For Terrestrial Uses, do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment wash water. For Aquatic Uses do not apply directly to water except as specified on this label.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

Pesticide Storage: Keep pesticide in original container. Do not put concentrate or dilute into food or drink containers. Do not contaminate feed, foodstuffs, or drinking water. Do not store or transport near feed or food. Store at temperatures above 32°F. For help with any spill, leak, fire, or exposure involving this material, call 1-800-888-8372.

Pesticide Disposal: Open dumping is prohibited. Pesticide wastes are toxic. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

Container Disposal: Do not reuse container. Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or incineration, or if allowed by State and local authorities, by burning. If burned, stay out of smoke.

For minor spills, leaks, etc., follow all precautions indicated on this label and clean up immediately. Take special care to avoid contamination of equipment and facilities during cleanup procedures and disposal of wastes. In the event of a major spill, fire, or other emergency, call 1-800-888-8372, day or night.

CONTAINER IS NOT SAFE FOR FOOD, FEED, OR DRINKING WATER!

syngenta®

APPENDIX B HERBICIDE FACT SHEETS

Technical Factsheet on: DIQUAT

List of Contaminants

As part of the Drinking Water and Health pages, this fact sheet is part of a larger publication:
National Primary Drinking Water Regulations

Drinking Water Standards
MCLG: 0.02 mg/L
MCL: 0.02 mg/L
HAL(child): none

Health Effects Summary

Acute: EPA has found diquat to potentially cause the following health effects from acute exposures at levels above the MCL: dehydration.

Drinking water levels which are considered "safe" for short-term exposures have not been established.

Chronic: Diquat has the potential to cause the following health effects from long-term exposures at levels above the MCL: cataracts.

Cancer: There is inadequate evidence to state whether or not diquat has the potential to cause cancer from a lifetime exposure in drinking water.

Usage Patterns

Diquat is a herbicide that has been used extensively in the US since the late 1950s to control both crop and aquatic weeds. Its uses include potato haulm destruction; as a desiccant and defoliant to aid harvesting cotton, rapeseed and other oil seed crops; to pre-wilt silage, standing hay, etc. for storage; a plant growth regulator and sugar cane-flowering suppressant. Diquat usage in 1980 was estimated to be 200,000 lbs. of active ingredient. 1982 data indicates that diquat was not produced domestically, but imports were nearly 835,000 lbs. In 1982 it was estimated that diquat usage patterns were as follows: Industrial/commercial uses, 67%; aquatic uses, 33%.

Release Patterns

Diquat is released into the environment during its use as a contact herbicide, aquatic weed control agent, seed desiccant and sugarcane flowering suppressant agent. It may also be released into wastewater or in spills during its manufacture, transport and storage.

Since diquat is not a listed chemical in the Toxics Release Inventory, data on releases during its manufacture and handling are not available.

Environmental Fate

Diquat is rapidly adsorbed by clay constituents of soil and in the sorbed state is resistant to biodegradation and photodegradation. The duration of residual activity in soil is a few days; the deactivation resulting from its binding to the soil. In some soils such as montorillonite clay, adsorption is considered irreversible. There is some evidence of a more loosely bound component, the fraction of which depends on the type of soil.

Diquat is removed rapidly from aquatic systems, principally by adsorption. If adsorption is initially to weeds, biodegradation to soluble or volatile products occurs in several weeks. When sorbed to sediment, little or no degradation probably occurs. In any case, the diquat disappears from the water in 2-4 weeks. Diquat will photodegrade in surface layers of water in 1-3 or more weeks when not adsorbed to particulate matter.

Should diquat be released to the atmosphere during spraying operations, it would be associated with aerosols. It will be subject to photolysis (half-life approx 48 hrs) and gravitational settling.

Little or no bioconcentration in fish will occur, as is expected for a chemical whose log octanol/water partition coefficient is -3.05. No residues were detected in organs or tissues of channel catfish collected from pools 5 months after a single application or 2 months after a second treatment of 1 ppm diquat.

Human exposure will principally be by agriculture workers or others who use the chemical or are in the vicinity of fields or bodies of water where diquat is used.

Chemical/ Physical Properties

CAS Number: 85-00-7

Color/ Form/Odor: Colorless to yellow crystals; water solution is dark reddish brown

M.P.: 335-340 C B.P.: N/A

Vapor Pressure: 1.3x10-5 mm Hg at 20 C

Octanol/Water Partition (Kow): Log Kow = -3.05

Density/Spec. Grav.: 1.22 - 1.27 at 20 C

Solubility: 700 g/L of water at 20 C; Very soluble in water

Soil sorption coefficient: Koc N/A; very low mobility in soil

Odor/Taste Thresholds: N/A

Bioconcentration Factor: Not expected to bioconcentrate in aquatic organisms.

Henry's Law Coefficient: N/A; no evaporation from water/soil

Trade Names/Synonyms: 1,1-Ethylene 2,2-dipyridylium dibromide; Reglone

Other Regulatory Information

Monitoring For Ground/Surface Water Sources:

Initial Frequency- 4 quarterly samples every 3 years
Repeat Frequency- If no detections during initial round:
    2 quarterly per year if serving >3300 persons;
    1 sample per 3 years for smaller systems
Triggers - Return to Initial Freq. if detect at > 0.0004 mg/L

Analysis:

Reference Source	Method Numbers
EPA 600/4-88-039	549.1

Treatment- Best Available Technologies:
Granular Activated Charcoal

For Additional Information:

EPA can provide further regulatory and other general information:
EPA Safe Drinking Water Hotline - 800/426-4791

Other sources of toxicological and environmental fate data include:
Toxic Substance Control Act Information Line - 202/554-1404
Toxics Release Inventory, National Library of Medicine - 301/496-6531
Agency for Toxic Substances and Disease Registry - 404/639-6000
National Pesticide Hotline - 800/858-7378

Fluridone (Sonar®)

March 2000

Fact Sheet

Environmental Health Programs
Office of Environmental Health & Safety

Washington State Department of Health

Fluridone is an aquatic herbicide used to control common nuisance plants like pondweed and watermilfoil. It is not equally effective at killing all water plants and has been used in Washington to selectively remove certain nuisance weeds. It is absorbed by the leaves, shoots and roots of vascular plants and kills susceptible plants by inhibiting their ability to form carotene, a substance which plants need to maintain essential levels of chlorophyll. Damage in susceptible plants usually appears in 7-10 days after water treatment.

Fluridone is the active ingredient in Sonar® and comes in two formulations: pellets (Sonar SRP) and liquid concentrate (Sonar A.S.)

The initial rate of application recommended by Sonar labels is quite dilute and varies depending on the size of pond or lake, density of weeds, and susceptibility of targeted weeds. Control of watermilfoil in Washington is often accomplished with rates as low as 10-20 parts per billion (ppb).

Environmental Persistence

Fluridone is moderately persistent in water and sediments following treatment of a pond or lake. Field tests have shown that the average half-life in pond water is 21 days and longer in sediments (90 days in hydrosoil). Residues may persist longer depending on the amount of sunlight and the water temperature. Fluridone is primarily degraded by sunlight and microorganisms.

Health Impacts

Laboratory animals (mice, rats, dogs) fed fluridone in their diets showed little signs of toxicity even when fed levels which far exceed potential human exposure from use of Sonar. Fluridone is not considered to be a carcinogen or mutagen and is not associated with reproductive or developmental effects in test animals.

There is no EPA standard for maximum allowable concentration (MCL) of fluridone in public water supplies. For the purpose of Sonar product registration, EPA determined that 150 ppb is an acceptable level for potable water following Sonar use. This level provides a 1000-fold safety factor between the no effect level in experimental animals and the estimated human exposure via drinking water.

Common Questions

Can I use treated lake water for drinking? The Sonar label prohibits application to water within 1/4 mile of functioning potable water intakes unless the treatment rate is 20 ppb or less. Estimated human exposure from daily consumption of water with 20 ppb of fluridone is 10,000-fold less than the no effect level in test animals. People who wish to avoid even minimal residues can do so by filtering their drinking water with a charcoal-based filter.

Can I swim and fish in treated water? There are no swimming or fishing restrictions associated with fluridone treatment. Fluridone does not significantly bioaccumulate or biomagnify in fish. Consumption of fish from treated water does not pose a threat to human health.

Can fluridone leach into groundwater wells, which are shallow and close to a treated water body? Fluridone tends to bind to organic matter and should not leach into groundwater from aquatic sediments. Fluridone shows a limited ability to leach if applied to soil.

What about the other ingredients in Sonar? "Inert" ingredients included in formulations of fluridone are confidential. DOH was permitted to review the list of inerts in Sonar and concluded that these chemicals are not of human concern at applied concentrations.

Can I use treated water for watering domestic plants? For information about susceptibility of specific plants, consult the product label or contact the manufacturer. According to the manufacturer, Sonar used at the maximum-labeled rate (150 ppb) may affect domestic plants, especially plants in the *Solanaceae* family (tomato, potato, eggplant, peppers etc.). More dilute concentrations are unlikely to affect domestic plants. Again, a charcoal-based filter will remove fluridone residues from water.

Need More Information?

Please Contact:

- Your county health agency
- Washington State Department of Health Pesticide Program (360)236-3360
- Washington State Department of Ecology Water Quality Program (360)407-6563
- Sepro is the company which manufactures Sonar products. Material Safety Data Sheets and current copies of Sonar labels are available by calling 1-800-419-7779 or at the Sepro website www.sepro.com/aquatics/sonar/index.html
- Additional copies of this fact sheet can be obtained from:
  Office of Environmental Health & Safety
  P.O. Box 47825
  Olympia, Washington 98504-7825
  Tollfree: (888) 586-9427

Technical Factsheet on: DIQUAT

List of Contaminants

As part of the Drinking Water and Health pages, this fact sheet is part of a larger publication:
National Primary Drinking Water Regulations

Drinking Water Standards
MCLG: 0.02 mg/L
MCL: 0.02 mg/L
HAL(child): none

Health Effects Summary

Acute: EPA has found diquat to potentially cause the following health effects from acute exposures at levels above the MCL: dehydration.

Drinking water levels which are considered "safe" for short-term exposures have not been established.

Chronic: Diquat has the potential to cause the following health effects from long-term exposures at levels above the MCL: cataracts.

Cancer: There is inadequate evidence to state whether or not diquat has the potential to cause cancer from a lifetime exposure in drinking water.

Usage Patterns

Diquat is a herbicide that has been used extensively in the US since the late 1950s to control both crop and aquatic weeds. Its uses include potato haulm destruction; as a desiccant and defoliant to aid harvesting cotton, rapeseed and other oil seed crops; to pre-wilt silage, standing hay, etc. for storage; a plant growth regulator and sugar cane-flowering suppressant. Diquat usage in 1980 was estimated to be 200,000 lbs. of active ingredient. 1982 data indicates that diquat was not produced domestically, but imports were nearly 835,000 lbs. In 1982 it was estimated that diquat usage patterns were as follows: Industrial/commercial uses, 67%; aquatic uses, 33%.

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Diquat is removed rapidly from aquatic systems, principally by adsorption. If adsorption is initially to weeds, biodegradation to soluble or volatile products occurs in several weeks. When sorbed to sediment, little or no degradation probably occurs. In any case, the diquat disappears from the water in 2-4 weeks. Diquat will photodegrade in surface layers of water in 1-3 or more weeks when not adsorbed to particulate matter.

Should diquat be released to the atmosphere during spraying operations, it would be associated with aerosols. It will be subject to photolysis (half-life approx 48 hrs) and gravitational settling.

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Human exposure will principally be by agriculture workers or others who use the chemical or are in the vicinity of fields or bodies of water where diquat is used.

Chemical/ Physical Properties

CAS Number: 85-00-7

Color/ Form/Odor: Colorless to yellow crystals; water solution is dark reddish brown

M.P.: 335-340 C B.P.: N/A

Vapor Pressure: 1.3x10-5 mm Hg at 20 C

Octanol/Water Partition (Kow): Log Kow = -3.05

Density/Spec. Grav.: 1.22 - 1.27 at 20 C

Solubility: 700 g/L of water at 20 C; Very soluble in water

Soil sorption coefficient: Koc N/A; very low mobility in soil

Odor/Taste Thresholds: N/A

Bioconcentration Factor: Not expected to bioconcentrate in aquatic organisms.

Henry's Law Coefficient: N/A; no evaporation from water/soil

Trade Names/Synonyms: 1,1-Ethylene 2,2-dipyridylium dibromide; Reglone

Other Regulatory Information

Monitoring For Ground/Surface Water Sources:

Initial Frequency- 4 quarterly samples every 3 years
Repeat Frequency- If no detections during initial round:
    2 quarterly per year if serving >3300 persons;
    1 sample per 3 years for smaller systems
Triggers - Return to Initial Freq. if detect at > 0.0004 mg/L

Analysis:

Reference Source	Method Numbers
EPA 600/4-88-039	549.1

Treatment- Best Available Technologies:
Granular Activated Charcoal

For Additional Information:

EPA can provide further regulatory and other general information:
EPA Safe Drinking Water Hotline - 800/426-4791

Other sources of toxicological and environmental fate data include:
Toxic Substance Control Act Information Line - 202/554-1404
Toxics Release Inventory, National Library of Medicine - 301/496-6531
Agency for Toxic Substances and Disease Registry - 404/639-6000
National Pesticide Hotline - 800/858-7378

Washington State Department of Health

April 2004

Health Questions and Answers

On use of triclopyr to treat Eurasian watermilfoil

What is triclopyr?

Triclopyr *(pronounced tri–clo–peer)* is an herbicide that can control infestations of *Eurasian watermilfoil* and other invasive water plants. *E. watermilfoil* is more sensitive to triclopyr than many native pond weed species including coontail, rushes and cattails. Triclopyr can therefore be used at low concentrations to remove *E. watermilfoil* without killing many native plants. One triclopyr product is currently marketed for aquatic weeds under two names: Garlon 3A and Renovate 3. Both products contain mostly triclopyr and water. Other ingredients include ethanol, 3% triethylamine, and 2.3% ethylenediaminetetraacetic acid (EDTA). The whole product, including these other ingredients, is diluted more than 100,000-fold during an application for *E. watermilfoil*.

How toxic is triclopyr?

Only dilute amounts of triclopyr are needed to kill *E. watermilfoil*. These dilute concentrations have not been shown to cause skin irritation or other health effects. Triclopyr is not well absorbed through skin. If ingested, research has shown that low doses of triclopyr are rapidly excreted in humans and are unlikely to accumulate in human tissue or cause adverse effects. Concentrated triclopyr products are corrosive and can cause skin irritation and irreversible eye damage. Pesticide applicators must take care to protect their eyes and skin during the application.

In natural waters, the initial breakdown products of triclopyr are TCP and TMP.[1] Tests in laboratory animals on both these metabolites have shown that their toxicity to mammals is less than or equal to triclopyr. These metabolites are relatively short-lived in the environment. Complete breakdown of triclopyr results in carbon dioxide, oxamic acid, and other low molecular weight carboxylic acids.

Triclopyr is not considered by the EPA to be a cause of cancer, birth defects, or genetic mutations. Nor is it considered likely to cause systemic, reproductive, or developmental effects in mammals at or near concentrations encountered during normal human use.

[1] TCP is 3,5,6-trichloro-2-pyridinol. TMP is 3,5,6-trichloro-2-methoxypyridine

Washington State Department of Health considers it prudent public health advice to minimize exposure to pesticides regardless of their known toxicity.

How long will the herbicide last in the lake water?

In natural water, sunlight and microorganisms rapidly degrade triclopyr.

Triclopyr concentrations decline sharply over the first several days after treatment. Residues should be more than 95% degraded and dissipated from treated water in 1-2 weeks following treatment with triclopyr.

If Capitol Lake is treated with triclopyr, will I be exposed to this herbicide?

Residues of triclopyr and its metabolites should not be detectable in lake water more than a couple weeks past the application. Capitol Lake is not commonly used for swimming or other water play. If you do wade or swim in the lake, touch pets that have been in the lake, or eat fish from treated water shortly after the treatment, you may be exposed to dilute concentrations of triclopyr and its metabolites.

There is little chance of inhalation exposure to bystanders. This is because liquid triclopyr herbicide is injected directly into the water column. The application method eliminates opportunity for drift of sprays onto bystanders or nearby residents during the application. Triclopyr has a low vapor pressure and is quite water-soluble so it will not volatilize from treated water and drift through air following the application.

Is it safe to swim or play in the water following the herbicide application?

There are no swimming restrictions on the Garlon 3A or Renovate 3 labels following applications of triclopyr to water. This means that the federal Environmental Protection Agency (EPA) considers the treated water safe for swimming.

Washington State Department of Ecology recently contracted for an independent scientific assessment of triclopyr safety including this question of a swimmer's exposure. The worst-case scenario considered a 6 year-old who swims for 3 hours and inadvertently swallows 150 ml of water from the treated water immediately following an milfoil application with triclopyr. The estimated amount the child would absorb in this scenario was still more than 100 times less than the daily dose animals were fed over their lifetime with no observable adverse effects.

Washington State Department of Health (DOH) has reviewed the data and agrees that skin contact with treated water at the dilute treatment concentration is unlikely to result in any adverse health effect in people. Triclopyr products are concentrated when initially injected into water during an application so, as a precaution, DOH advises people to avoid contact with water

in treated areas for twelve hours following an application to allow the herbicide concentrate to disperse and reach the dilute treatment concentration.

Are fish from the treated area safe to eat?

One breakdown product of triclopyr, called TMP, can temporarily accumulate in fish and shellfish immediately following a triclopyr application. The EPA did not consider the concentration of this metabolite to be of health concern and requires no fishing restrictions.

Washington State Department of Ecology recently contracted for an independent scientific assessment of triclopyr safety including this question of eating fish from treated waters. Scenarios for children and adults consuming fish every day from treated water resulted in estimated exposures that were more than 1000 times less than the daily doses animals were fed over their lifetime with no observable adverse effects.

Has Triclopyr been tested for special sensitivity to children?

The EPA is required to assess each pesticide for its potential to cause toxicity specifically to infants and young children. This is because children's bodies are still developing and they may be more susceptible to the action of a toxicant. EPA conducted this assessment using animal tests and concluded "Reliable pre-and post-natal data indicate no special sensitivity of young animals to triclopyr residues."

FOR MORE INFORMATION CONTACT:

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(360) 236-3360

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1-800-858-7378
This hotline provides pesticide information to the public and health care providers. Funding comes from state university cooperative extension and from the Environmental Protection Agency.

Risk Assessments of triclopyr that are available online:

http://www.epa.gov/oppsrrd1/REDs/factsheets/2710fact.pdf (fact sheet on triclopyr by EPA)
http://www.epa.gov/oppsrrd1/REDs/2710red.pdf (detail risk assessment of triclopyr by EPA)
http://www.ecy.wa.gov/pubs/0410018.pdf (Environmental Impact Statement for use of triclopyr on aquatic weeds, prepared by WA Dept of Ecology)

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APPENDIX C HERBICIDE FREQUENTLY ASKED QUESTIONS

Sonar*

An Effective Herbicide That Poses
Negligible Risk To Human Health
And The Environment

SONAR*
An Effective Herbicide That Poses Negligible Risk To Human Health And The Environment

Sonar is a highly effective aquatic herbicide used to selectively manage undesirable aquatic vegetation in freshwater ponds, lakes, reservoirs, rivers and canals. Sonar is absorbed through the leaves, shoots, and roots of susceptible plants, and destroys the plant by interfering with its ability to make and use food. As with any substance introduced into the environment, concerns arise about possible harmful effects on humans who may come into contact with it, and about its effects on wildlife and plants that we wish to protect and preserve. The following discussion, presented in a "Question and Answer" format, provides information regarding Sonar and evidence that Sonar presents negligible risk[1] to human health and the environment when applied according to its legally allowed uses and label directions.

Q1. What are the legally approved uses of Sonar?

A1. Sonar has been approved for use by the U.S. Environmental Protection Agency (USEPA) since 1986 for the management of aquatic vegetation in freshwater ponds, lakes, reservoirs, drainage canals, irrigation canals and rivers. Four different formulations have been approved for use—an aqueous suspension known as Sonar A.S. (USEPA Registration Number 67690-4) and three pellet forms known as Sonar SRP (USEPA Registration Number 67690-3), Sonar PR Precision Release (USEPA Registration Number 67690-12), and Sonar Q Quick Release (USEPA Registration Number 67690-3). There are no USEPA restrictions on the use of Sonar-treated water for swimming or fishing when used according to label directions. The Agency has approved Sonar's application in water used for drinking as long as residue levels do not exceed 0.15 parts per million (ppm) or 150 part per billion (ppb). For reference, one (1) ppm can be considered equivalent to roughly one second in 12 days or one foot in 200 miles, and (0.1) ppm can be considered approximately equal to one second in 120 days or one foot in 2,000 miles.

Sonar's USEPA-approved labeling states that in lakes and reservoirs that serve as drinking water sources, Sonar applications can be made up to within one-fourth mile (1,320 feet) of a potable water intake. For the control of Eurasian watermilfoil, curlyleaf pondweed and hydrilla where treatment concentrations are 0.01 to 0.02 ppm (10 to 20 ppb), this setback distance of one-fourth mile from a potable water intake is not required. Note that these effective treatment concentrations are well below the 0.15 ppm (150 ppb) allowable limit in water used for drinking.

Local public agencies may require permits for use of an herbicide in public waters. Therefore, the Sonar label states that the user must consult appropriate state or local water authorities before applying the herbicide.

[1]Throughout this document, we use the phrases "negligible risk" or "no significant risk." We use these terms because it is beyond the capabilities of science to prove that a substance is absolutely safe, i.e., that the substance poses no risk whatsoever. Any substances, be it aspirin, table salt, caffeine, or household cleaning products, will cause adverse health effects at sufficiently high doses. Normal exposures to such substances in our daily lives, however, are well below those associated with adverse health effects. At

some exposure, risks are so small that, for all practical purposes, no risk exists. We consider such risks to be negligible or insignificant.

*Trademark of SePRO Corporation

Q2. How does a product such as Sonar gain approval for use? (How does it become registered?)

A2. Federal law requires that an aquatic herbicide be registered with the USEPA before it can be shipped or sold in the United States. To obtain registration, manufacturers are required to conduct numerous studies (i.e., over 120 studies depending upon the intended uses) and to submit a thorough and extensive data set to USEPA to demonstrate that, under its conditions of use, the product will not pose a significant risk to human health and the environment and that the herbicide is effective against the target weeds or plants.

Individual states can establish registration standards that are more strict than federal standards, but not less strict.

Q3. What types of information must be submitted to regulatory agencies before an herbicide is registered?

A3. To register a herbicide, the manufacturer must submit information that falls into the following categories: product chemistry (for example, solubility, volatility, flammability and impurities), environmental fate (for example, how the substance degrades in the environment), mammalian toxicology (studies in laboratory animals used to assess potential health risks to humans), and wildlife and aquatic (for example, bird and fish) toxicology. If there are any residues in the environment, their levels must be determined. A manufacturer also conducts studies of product performance (or efficacy as a herbicide).

Q4. Have all of the data required for registration of Sonar been submitted to regulatory agencies, and have those agencies found the data acceptable?

A4. The data required for registration of Sonar by the USEPA is complete and has been accepted by the USEPA and by all states.

Q5. What happens to Sonar when it is used according to approved labeling -- that is, what is its environmental fate or what happens to Sonar once it is released or applied to the water?

A5. Tests under field conditions show that Sonar disappears from treated water in a matter of weeks or months, depending on a number of environmental factors such as sunlight, water temperature and depth. In lakes, reservoirs, rivers and canals where only a portion of the water body is treated, dilution reduces the level of Sonar relatively quickly following application.

Sonar does not persist in the environment. Its disappearance from aquatic environments is accomplished by several processes. First, the plants that are being

treated absorb Sonar, thereby removing a portion of it from the water. Second, Sonar degrades or breaks down in the presence of sunlight by a process called "photo degradation." Photo degradation is the primary process contributing to the loss of Sonar from water. Third, adsorption of Sonar to hydrosoil (sediments) also contributes to its loss from water. As Sonar is released from hydrosoil back into the water, it is photo degraded.

Study results indicate that Sonar has a low bioaccumulation potential and therefore is not a threat to the food chain. Specifically, studies have shown that Sonar does not accumulate in fish tissue to any significant degree. The relatively small amounts of Sonar that may be taken up by fish following application are eliminated as the Sonar levels in water decline. In a study of crops irrigated with Sonar treated water, no residues of Sonar were found in any human food crops, and only very low levels were detected in certain forage crops. Consumption by livestock of Sonar-treated water and crops irrigated with Sonar-treated water was shown to result in negligible levels of Sonar in lean meat and milk. Sonar-treated water can be used immediately for watering livestock.

To ensure that residue levels of Sonar pose no significant risk, USEPA has established tolerances, or maximum legally allowable levels, in water, fish, and crops irrigated with Sonar-treated water, and other agricultural products (including eggs, milk, meat, and chicken). For example, the 0.15 ppm (150 ppb) concentration in water mentioned in the answer to Question #1 is the tolerance limit for water that is used for drinking. The recommended application rates of Sonar (detailed on the label) are established to ensure the product will do its job and that tolerance limits won't be exceeded.

Q6. How might people come into contact with Sonar after it is applied to an aquatic site?

A6. People could come into contact with Sonar by swimming in water bodies treated with the herbicide, by drinking water from treated lakes or reservoirs, by consuming game fish taken from treated waters, and by consuming meat, poultry, eggs or milk from livestock that were provided water from treated surface water sources.

Q7. Is it likely that people will be harmed because of those contacts?

A7. Extensive studies have demonstrated that contact with Sonar poses negligible health risks when the herbicide is used according to label instructions. The label for Sonar carries no restrictions for swimming or fishing in treated water or against drinking water treated with Sonar. Sonar does not build up in the body.

The conclusion that Sonar poses negligible health risks is evidenced by USEPA's toxicity rating for Sonar. The USEPA classifies herbicides according to their acute toxicity or potential adverse health effects and requires that a "signal word" indicating the relative toxicity of the herbicide be prominently displayed on the product label. Every herbicide carries such a signal word. The most acutely toxic herbicide category requires the signal word DANGER. However, if the product is especially toxic, the additional word POISON is displayed. Herbicides of moderate acute toxicity require the signal word WARNING. The least toxic products require the signal word CAUTION. Sonar labels display the word CAUTION, the USEPA's lowest acute toxicity rating category.

Q8. How do we know that humans are not likely to experience any harmful effects from Sonar's temporary presence in the environment?

A8. Companies that develop new herbicides are required to: 1) conduct extensive investigations of the toxicology of their product in laboratory animals; 2) characterize the ways by which people may contact the herbicide after it has been applied to an aquatic site; 3) determine the amount of exposure resulting from these possible contacts; and 4) demonstrate the fate of the herbicide in the environment. Before USEPA will register a herbicide, the Agency must establish with a high degree of certainty that an ample safety margin exists between the level to which people may be exposed and the level at which adverse effects have been observed in the toxicology studies.

Investigations of the toxicity of Sonar have been performed in laboratory animals under a variety of exposure conditions, including exposure to very high doses for short periods (acute studies), as well as repeated exposures to lower doses (which are still far in excess of any exposures that humans might actually receive) throughout the lifetime of the laboratory animals (chronic studies). Other special studies have been performed to evaluate the potential for Sonar to cause reproductive effects, cancer, and genetic damage. Study results indicate a low order of toxicity to mammalian species following acute exposures and repeat-dose exposures for up to a lifetime. In addition, repeated doses of Sonar did not result in the development of tumors, adverse effects on reproduction or on development of offspring, or genetic damage.

In characterizing the toxicity of a compound and its safety margin for exposures of humans and wildlife, toxicologists attempt to identify the maximum dose at which a chemical produces no toxicity. Another way of stating this is how much of the chemical can an organism be exposed to before it reaches a toxic level (recall from the footnote to the introduction on page 1 that all substances are toxic at some dose or level). This maximum non-toxic dose is usually established by studies in laboratory animals and is reported as the "no-observed-effect level" or NOEL. The dietary NOEL for Sonar (that is, the highest dose at which no adverse effects were observed in laboratory animals fed Sonar) is approximately 8 milligrams of Sonar per kilogram of body weight per day, abbreviated 8 mg/kg/day. This NOEL was derived from a study in rats that were fed Sonar in their regular diets every day for their entire two-year lifetime.

To put this NOEL into perspective, a 70-kg adult (about 150 pounds) would have to drink over 1,000 gallons of water containing the maximum legally allowable concentration of Sonar in potable water (0.15 ppm) daily for a significant portion of their lifetime to receive a dose equivalent to the 8 mg/kg/day NOEL. At most, adults drink about 2 quarts (one-half gallon) of water daily, which means that even if a person were drinking water with the maximum legally allowable concentration of Sonar, their margin of safety would still be at least 2,000. Similarly, a 20-kg child (about 40 pounds) would have to drink approximately 285 gallons of Sonar-treated water every day to receive a dose equivalent to the NOEL. Because children drink only about one quart of water daily, this provides a safety margin of greater than 1,000.

The above example calculation of safety margins is based on the assumption that potable water will contain levels of Sonar at its maximum allowable concentration of 0.15 ppm (150 ppb). In fact, the Sonar concentration achieved under typical applications is closer to 0.02 ppm (20 ppb), thereby providing a safety margin seven times greater. The

point is that adults and children who drink water from potable water sources that have been treated with Sonar according to label instructions are at negligible risk.

Similarly, the levels of Sonar allowed in various food products pose negligible risk to human health. For example, even if Sonar were present at the maximum allowable limit of 0.05 ppm in meat, poultry, eggs, and milk, a 70-kg adult would have to consume almost 25,000 pounds of these foods daily (and again for a significant portion of a lifetime) to receive a dose equivalent to the dietary NOEL for Sonar. A child would have to consume over 7,000 pounds of these foods daily.

Because Sonar is used only intermittently in any one area, and because it disappears from the environment, there is virtually no way that anyone will be exposed continuously for a lifetime. Because the NOEL derives from a study involving daily exposures for a lifetime, the actual safety margin for people is, in fact, much greater than is suggested by the above illustrative examples.

Q9. How complete is the toxicology information upon which this conclusion rests?

A9. All toxicity studies required by the USEPA to obtain registration approval for Sonar have been completed.

Q10. What about the people who apply Sonar—are they at risk?

A10. The Sonar label states that individuals who use Sonar should avoid breathing spray mist or contact with skin, eyes, or clothing; should wash thoroughly with soap and water after handling; and should wash exposed clothing before reuse. These precautions are the minimum recommendations for the application of any pesticide. If Sonar is used according to label instructions, exposures to the product should be minimal and use should pose negligible risks to applicators.

Sonar has been shown to be of low acute toxicity in laboratory animal studies (that is, toxicity from a high dose exposure for a short period of time). Therefore, any exposure to the product (even undiluted) that might occur during use is unlikely to lead to adverse effects as long as label instructions are followed. As discussed in Question #7, Sonar's label carries the signal word CAUTION that corresponds to the USEPA's lowest acute toxicity rating category.

Studies in laboratory animals show that the lethal dose from a single oral exposure of Sonar is greater than 10,000 mg/kg. To put this into perspective, an adult would have to drink over one million gallons of Sonar-treated water (at the 0.15 [150 ppb] ppm maximum allowable limit) to receive a dose of 10,000 mg/kg; a 20-kg child would have to drink approximately 350,000 gallons.

Because applicators are more likely to contact the undiluted material than the general population, questions about the toxicity of Sonar following direct skin contact have been raised. A laboratory study of the toxicity of an 80 percent solution of Sonar applied to rabbit skin (a standard model to predict effects in humans) suggests that Sonar is minimally toxic by this route. In this study, when Sonar was repeatedly applied to the skin of rabbits for 21 days (in the largest amounts that could be applied practically), there were no signs of toxicity and only slight skin irritation was observed. Further, the dermal

administration of the 80 percent solution of Sonar did not induce sensitization in guinea pigs.

Q11. Has there been any investigation of the possible harmful effects of Sonar on fish, wildlife, pets and livestock?

A11. The toxicity of Sonar has been investigated in laboratory studies in birds (including the bobwhite quail and mallard duck), in the honey bee (as a representative insect) and in the earthworm (as a representative soil organism), in five different species of freshwater and marine fish, and in other aquatic animals. These studies have involved exposures to high concentrations for brief periods as well as exposures lasting as long as an entire lifetime, including during reproduction.

Extensive studies have also been performed to evaluate the effects of Sonar on various aquatic and terrestrial plants (both those considered undesirable aquatic weeds and those native plants that we wish to protect). Studies in laboratory animals designed primarily to assess potential health risk in humans are also relevant to the assessment of potential health effects in mammalian wildlife, livestock, and pets.

In addition, **Sonar** has been monitored in water, plants and fish during field trials. This provides firsthand information on residue levels in the environment following application of Sonar.

Q12. What do these investigations reveal?

A12. A combination of the toxicity studies and residue monitoring data reveals that Sonar poses negligible risks to aquatic animals including fish, wildlife, pets, and livestock when used according to label directions.

As was done with laboratory mammals, toxicity studies were conducted to establish a dietary no-observed effect level (NOEL) for birds. This maximum, non-toxic chronic dose is 1,000 ppm in the diet. One thousand (1,000) ppm is 2,500 times the highest average concentration of total residue found in fish (0.40 ppm), about 2,100 times the highest concentration found in aquatic plants (0.47 ppm), and about 11,500 times the highest average concentration of Sonar found in the water at field trial sites (0.087 ppm). Because the residue levels in these “bird food” items are so far below the NOEL, it can be concluded is that there are negligible risks to birds that might be exposed to Sonar in their diet following application of Sonar.

The highest average Sonar concentration found in Sonar-treated water is below the lowest NOEL values for both short and long term exposures from freshwater and marine fish. Honeybees and earthworms are not particularly sensitive to Sonar. Sonar caused no deaths in honey bees when they were dusted directly with the herbicide, and earthworms were not affected when they were placed in soil containing more than 100 ppm Sonar.

Extensive testing of Sonar in laboratory animals used to assess potential risks to human health indicates that a large safety margin exists for mammalian species in general. Thus, Sonar poses negligible risk to pets, livestock, and mammalian wildlife that might drink from water treated with Sonar.

Q13. Can Sonar be used in environmentally sensitive areas?

A13. Sonar has been used in a wide range of aquatic environments in the United States without incident for almost 15 years. Florida canals and rivers are examples of environmentally sensitive areas that have been treated with Sonar. Some sites are habitats for the endangered Florida manatee. Although toxicity testing data for the manatee, or for other endangered species, cannot be collected directly, questions about whether Sonar treatment will pose any significant risk to the manatee can be answered with results of the mammalian toxicity studies.

The Florida manatee is an aquatic mammal that consumes up to 20% (one-fifth) of its body weight per day in aquatic plants. Treatment of canal water with Sonar according to label directions is expected to result in a maximum Sonar concentration of 0.15 ppm in the water and from 0.8 to 2.6 ppm in aquatic plants. Calculations show that it would be impossible for a manatee to ingest enough Sonar in its diet to cause any adverse effects, based on results of laboratory studies in other mammals. To reach the maximum non-toxic dose or NOEL for sensitive mammalian species, a manatee would have to drink more than 40 times its body weight per day in treated water, or eat at least 3 to 10 times its body weight per day in aquatic plants. This calculation indicates that treatment with Sonar in manatee habitats—as one example of an environmentally sensitive area—will pose negligible risk. In fact, application to Florida canals and rivers has been approved by the U.S. Fish and Wildlife Service, Florida Department of Environmental Protection, and the Florida Game and Fresh Water Fish Commission.

Sonar has also been used in other environmentally sensitive areas such as Disney World, Ducks Unlimited MARSH projects, Sea World, state and federal parks, and numerous fish and waterfowl management areas.

Q14. What is it that makes Sonar an effective aquatic herbicide while being a compound of relatively low toxicity to humans?

A14. Sonar inhibits a plant's ability to make food. Specifically, Sonar inhibits carotenoid synthesis, a process specific only to plants. Carotenoids (yellow, orange and red pigments) are an important part of the plant's photosynthetic (food making) system. These pigments protect the plant's green pigments (called chlorophyll) from photo degradation or breakdown by sunlight. When carotenoid synthesis is inhibited, the chlorophyll is gradually destroyed by sunlight. As a plant's chlorophyll decreases, so does its capacity to produce carbohydrates (its food source) through photosynthesis. Without the ability to produce carbohydrates, the plant dies.

Humans do not have carotenoid pigments. Therefore, the property of Sonar that makes it an effective herbicide at low doses does not affect the human body.

Q15. Will Sonar have an adverse effect on water quality?

A15. Extensive testing of a wide range of water bodies has shown no significant changes in water quality after Sonar treatment. In fact, Sonar has a practical advantage over certain other aquatic herbicides in this area. Specifically, the dissolved oxygen content of the water does not change significantly following Sonar treatment because the relatively slow herbicidal activity of the product permits a gradual decay of the treated vegetation. Maintaining adequate dissolved oxygen levels are critical to fish and other

aquatic animals, which require oxygen to survive. This contrasts with the changes in water quality that can arise from the application of certain other aquatic herbicides that are "fast-acting." The sudden addition of large amounts of decaying plant matter to the water body can lead to decreased oxygen levels and result in a fish kill. To avoid depressions in dissolved oxygen content, label directions for certain "fast-acting" aquatic herbicides recommend that only portions of areas of dense weeds be treated at a time. Because Sonar does not have any substantial impact on dissolved oxygen, it is possible to treat an entire water body with Sonar at one time.

Q16. Is there any reason for concern about the inert ingredients used in Sonar?

A16. Inert ingredients are those components of the product that do not exhibit herbicidal activity; that is, the components other than Sonar. Water is the primary inert ingredient in Sonar A.S., making up approximately 45% of the formulation. The second largest (approximately 10%) inert is propylene glycol; a compound used in facial creams and other health and beauty products. Other inert ingredients are added to serve as wetters, dispersants, and thickeners in the formulation. Trace amounts of an antifoaming agent and a preservative are also added. The primary inert ingredient in the pelleted formulations is clay, which makes up approximately 89% of the formulation. Small amounts of a binder or coating solution are also added to reduce the dustiness of the pellets. None of the inert ingredients in Sonar formulations are on the USEPA's list of "Inerts of Toxicological Concern" or list of "Potentially Toxic Inerts/High Priority for Testing." Thus, there is no reason for concern about the inert ingredients used in Sonar.

Q17. Is it important to follow label directions for use and disposal of Sonar?

A17. Yes. It is a violation of federal law to use products, including Sonar, in a manner inconsistent with product labeling or to improperly dispose of excess products or rinsate. Although the results of extensive toxicity testing in the laboratory and in field trials indicate a low order of toxicity to non-target plants, animals, and people, Sonar, like all chemicals, will cause adverse effects at sufficiently high exposure levels. Failure to follow label directions for use and disposal of Sonar could result in environmental levels that exceeds the tolerances for Sonar established to be protective of human health and the health of pets, livestock and other wildlife. In addition, improper use of Sonar could result in unintended damage to non-target plants.

Q18. If Sonar is used in conformance with label directions, is there any reason to be concerned that Sonar will pose risk to human health or the environment?

A18. As discussed in the answers to the previous questions, results of laboratory and field studies and extensive use experience with Sonar in a wide range of water bodies strongly support the conclusion that Sonar will pose negligible risks to human health and the environment when used in conformance with label directions.

In summary, it can be said that Sonar has a favorable toxicological profile for humans. It has an overall low relative toxicity and it is not a carcinogen, mutagen or reproductive toxicant. Sonar also has a very good environmental profile for an aquatic product because of: 1) its low toxicity to non-target organisms; 2) its non-persistent behavior when applied to water bodies (i.e., it readily breaks down to carbon, hydrogen, oxygen, nitrogen and fluorine); and 3) its low bioaccumulation potential, which means it does not build up in the body or in the food chain.

Triclopyr Questions and Answers

These questions were submitted by the public. The questions were answered by a team of experts.

1. **What is triclopyr?**

   Triclopyr *(pronounced tri–clo–peer)* is an herbicide that can control infestations of Eurasian watermilfoil and other broad-leaf water plants. Eurasian watermilfoil is more sensitive to triclopyr than many native aquatic species including coontail, rushes and cattails. Triclopyr can therefore be used at label concentrations to remove Eurasian watermilfoil without killing many native plants. One triclopyr product is currently registered and marketed for aquatic weeds - Renovate 3™.

2. **There are two types of triclopyr. Which one is registered for aquatic use? What distinguishes these two types of triclopyr from each other?**

   Renovate 3™ (triethylamine salt of triclopyr – 3 lb/gal acid equivalent) is the only formulation of triclopyr registered by the US EPA as an aquatic herbicide. The other formulation Garlon 4 is a butoxyethyl ester formulation with 4 lb/gal acid equivalent and this formulation is not registered for aquatic use.

3. **Has a full risk assessment been performed on triclopyr? If so, by whom?**

   An Environmental Impact Statement (EIS) has been completed by the Washington Department of Ecology and a full risk assessment was conducted by Ecology and formed the basis for the EIS.

4. **How toxic is triclopyr to humans?**

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

   In natural waters, the initial breakdown products of triclopyr are TCP and TMP. Tests in laboratory animals on both these metabolites have shown that their toxicity to mammals is less than or equal to triclopyr. These metabolites are relatively short-lived in the environment. Complete breakdown of triclopyr results in carbon dioxide, oxamic acid, and other low molecular weight carboxylic acids.

   Triclopyr is not considered to be a cause of cancer, birth defects, or genetic mutations. Nor is it considered likely to cause systemic, reproductive, or

developmental effects in mammals at or near concentrations encountered during normal human use. However, Washington State Department of Health considers it prudent public health advice to minimize exposure to pesticides regardless of their known toxicity.

5. **Does triclopyr accumulate in human and animals?**

   Triclopyr and its metabolites are excreted rapidly in humans and mammals. A study in human volunteers, given low doses showed that blood levels peaked two to three hours after ingestion and declined to undetectable levels within 48 hrs. A studies in rodents showed that triclopyr and metabolites have a short residence time in other bodily tissues (12-15 hours).

6. **Is there any relationship between triclopyr and cancer?**

   Triclopyr was determined to be "not classifiable as to human carcinogenicity" by EPA reviewers. This means the EPA did not consider the animal evidence to be sufficient to list triclopyr as a possible human carcinogen. Nor did it find the evidence definitive enough to rule out carcinogenicity. EPA considered results of the a 22 month assay in mice, a 24 month assay in rat, and results from *in vitro* tests for mutations. There were marginal increases in some breast tumors (benign) but no consistent pattern across dose groups and no dose-response pattern. EPA does not consider this a data gap since the required studies were conducted and were acceptable to EPA.

7. **Does triclopyr have impacts on reproduction?**

   EPA requires that pesticides be assessed for reproductive effects. In the reproductive tests two generations of rodents are fed the pesticide in their daily diet. It is common that pesticides have a positive response at the highest dose tested. This is because the test protocol requires the highest dose to be high enough to elicit a reproductive effect (unless the dose required causes death or severe suffering of the animal). Generally the highest dose must show an effect or the test is unacceptable to EPA. Impairment of reproduction by triclopyr was seen only at doses high enough to cause toxicity to the mothers. No reproductive effects were seen at lower doses. The high dose was very high relative to potential human exposure. It was 500 times the dose considered by EPA to be safe for daily exposure to humans and over 1400 times higher than the worst-case scenario for human exposure to triclopyr in lake treatments.

8. **At what levels of application is there documented evidence of impacts to people, fish, wildlife, microorganisms etc? Will these levels be achieved in applications to lakes to control Eurasian watermilfoil?**

   Renovate 3™ is used at levels no greater than 2.5 ppm (maximum labeled rate) in lakes. These levels have been found to be safe to the environment and non-target species based upon testing conducted for US EPA Registration.

9. **If my lake is treated with triclopyr, will I be exposed to this herbicide?**

   Residues of triclopyr and its metabolites should not be detectable in lake water more than a couple weeks past the application. If you do wade or swim in the lake, touch pets that have been in the lake, or eat fish from treated water shortly after the treatment, you may be exposed to dilute concentrations of triclopyr and its metabolites.

   There is little chance of exposure to bystanders during the herbicide application process. This is because liquid triclopyr herbicide is injected directly into the water column. The application method eliminates opportunity for drift of sprays onto bystanders or nearby residents during the application. Triclopyr has a low vapor pressure and is quite water-soluble so it will not volatilize from treated water and drift through air following the application.

10. **Is it safe to swim or play in the water following the herbicide application?**

    There are no swimming restrictions on the Renovate 3™ label following application of triclopyr to water. This means that the federal EPA considers the treated water safe for swimming. However, to impose an additional layer of safety to swimmers (due to potential for eye irritation) the Washington Department of Ecology is imposing a twelve hour swimming restriction in Washington after treatment with triclopyr.

    Washington State Department of Ecology recently contracted for an independent scientific assessment of triclopyr safety including this question of a swimmer's exposure. The most conservative scenario considered was a six-year-old who swims for three hours and inadvertently swallows 150 ml of water from a lake treated with the maximum allowable rate of triclopyr. The estimated amount the child would absorb in this scenario was still more than 100 times less than the daily dose animals were fed over their lifetime with no observable adverse effects.

    Washington State Department of Health (DOH) has reviewed the data and agrees that skin contact with treated water at the dilute treatment concentration is unlikely to result in any adverse health effect in people. Triclopyr products are concentrated when initially injected into water during an application so, as a precaution, DOH advises people to avoid contact with water in treated areas for twelve hours following an application to allow the herbicide concentrate to disperse and reach the dilute treatment concentration.

11. **Are fish from the treated area safe to eat?**

    One breakdown product of triclopyr, called TMP, can temporarily accumulate in fish and shellfish immediately following a triclopyr application. The EPA did not consider the concentration of this metabolite to be of health concern and requires no fishing restrictions.

    Washington State Department of Ecology recently contracted for an independent scientific assessment of triclopyr safety including this question of eating fish from treated

waters. Scenarios for children and adults consuming fish every day from treated water resulted in estimated exposures that were more than 1000 times less than the daily doses animals were fed over their lifetime with no observable adverse effects.

12. **Has triclopyr been tested for special sensitivity to children?**

The EPA is required to assess each pesticide for its potential to cause toxicity specifically to infants and young children. This is because children's bodies are still developing and they may be more susceptible to the action of a toxicant. EPA conducted this assessment using animal tests and concluded "Reliable pre-and post-natal data indicate no special sensitivity of young animals to triclopyr residues."

13. **What are the toxicity levels of triclopyr to aquatic organisms?**

For aquatic organisms, the acute toxicity values for triclopyr with rainbow trout, salmon species, bluegill sunfish, and the water flea (*D. magna*) are shown below in Text Table 1. Note: All testing done with laboratory water at pH of ~7-8, typical of conditions in the Pacific NW area, as demonstrated in Figure 1.

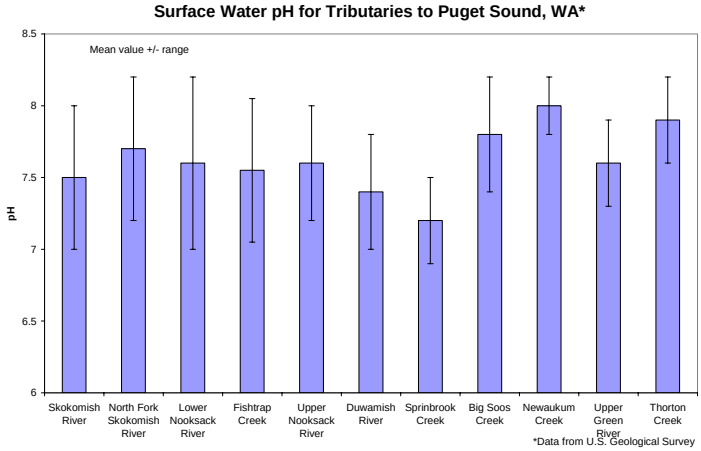


Figure 1. Surface water pH for Puget Sound tributaries (from U.S. Geological Survey)

Text Table 1. Acute toxicity data for aquatic species with Triclopyr

	R. Trout	Salmon sp.	Bluegill	Water Flea
Acute 96-hr LC50 (ppm)	86 to 117	82 to 182	148	133 (48-hr)

EPA Toxicity Rating: "Slightly toxic to Practically non-toxic"

The EPA classifies pesticides according to their acute toxicity responses. Compounds with acute values >100 ppm are classified "Practically non-toxic" (best rating), while compounds with acute values of 10-100 ppm are classified as "Slightly toxic" (second best classification). The overall weight of evidence indicates that triclopyr acute toxicity values average ~100 mg/L or greater with invertebrate and vertebrate species, indicating

that a collective “Practically non-toxic” rating is most appropriate as a generic classification.

14. **What does “practically non-toxic” mean?**

Practically non-toxic is an ecotoxicological category used to describe pesticides and other chemicals. In the chart below you will see that it is the lowest toxicological category.

Table II: Ecotoxicological Categories

Toxicity Category	Mammalian (Acute Oral)* mg/kg	Avian (Acute Oral)* mg/kg	Avian (Dietary)– ppm	Aquatic Organisms‡ ppm
very highly toxic	<10	<10	<50	<0.1
highly toxic	10-50	10-50	50-500	0.1-1
moderately toxic	51-500	51-500	501-1000	>1-10
slightly toxic	501-2000	501-2000	1000-5000	>10-100
practically non-toxic	>2000	>2000	>5000	>100

* Reflects dose given to test animals and is based on body weight of the test animal.
_Concentration in the diet. Unrelated to body weight of the test animal. Measure of environmental exposure.
‡Concentration in water. Unrelated to body weight of test animal. Measure of environmental exposure.

The words "pesticide" and "poison" are not synonymous. Relatively few pesticides are poisonous to humans according to the standard meaning of the term. “The dose makes the poison" is a saying all doctors understand. What it means, in essence, is that it’s not simply *what* you come in contact with or ingest that determines risk, it’s also *how much* you contact or ingest. This point is important because most pesticides are designed to control pests with amounts far smaller than the amount that would affect humans and pets. Contrary to popular belief, pesticides are not a uniquely toxic class of substances. They range from practically non-toxic to highly toxic—as with other classes of natural and manmade substances.

15. **Why does the Renovate 3™ label state to not apply to saltwater? Does it become toxic in a saltwater environment? Are salt water plants, creatures etc more susceptible to triclopyr than freshwater? If so how and why?**

A pesticide can only be directly applied to sites that it has been approved for through the US EPA label registration process. The label only indicates where a pesticide may be applied and does not restrict where residues may be discharged. Triclopyr does not become toxic in salt water. Salt water plants and animals should not be any more sensitive to triclopyr than the freshwater organisms that have been tested with triclopyr. As an example from the Renovate 3™ Material Safety Date Sheet (MSDS) the Acute

LC50 for pink shrimp (*Penaeus duorarum*) is 895 mg/L. This is over 350 times higher than the maximum rate that is normally applied to lakes.

16. **What are the long term affects of triclopyr on mammal systems - if it accumulated in mammalian tissue 5 yr, 10 yr, 20 yr. later?**

    Populations of several native mammals and birds were studied for several years following triclopyr, prescribed burning, and combination treatments in oak-savanna woodlands. Populations for all species showed either no change or increases following treatments. Thymus gland weights showed a statistically significant increase in burned areas both with and without triclopyr applications (Lochmiller et al. 1995). Recently published studies showed no impact of triclopyr applications on wildlife populations, relative to non-herbicide based vegetation management practices (Duchesne et al. 1999; Harpole and Haas 1999; Leslie et al. 1996; Leutenschlager et al. 1998; Lindgren et al. 1998; Nolte and Fulbright 1997). One study (Obenshain et al. 1997) reports that the combined use of triclopyr with 2,4-D and glyphosate may lead to concentrations of these herbicides in water that may cause adverse effects which are not detailed in the publication. In mammals, most triclopyr is excreted, unchanged, in the urine. Triclopyr was observed to concentrate slightly in ovaries of laboratory animals given repeated doses. No accumulation was observed in other tissues. The authors concluded that triclopyr and its metabolites are likely to have a low potential to accumulate upon repeated exposure (Timchalk et al. 1990). Data quoted from this website: http://www.fs.fed.us/r6/weeds/Triclopyr_Profile.PDF

17. **Could triclopyr possibly impact bats and or other mammals, especially bats that are pregnant or nursing their young?**

    Renovate3™ has a low potential for bioaccumulation. Triclopyr is typically found at a concentration in animals many times less than what is present within the surrounding water and is eliminated relatively quickly. The LD50 for Rats has ranged from 630-729 mg/Kg (Tu et. al.). Since the material does not bioaccumulate bats would not be able to develop concentrations that would affect them or their offspring by drinking treated water or foraging on insects from the treated water.

18. **What are the inert ingredients in triclopyr?**

    Garlon 3A™ and Renovate 3™ are identical products marketed under two names. Ingredients listed on either the pesticide label or Material Safety Data Sheet are:

    - triclopyr TEA salt (44.4%)
    - ethanol (amount not specified but more than 1%)
    - triethylamine 3%,
    - ethylenediamine tetraacetic acid 2.3%.

    The regulatory manager at Dow Agrosciences (manufacturer of triclopyr) disclosed that the product is more than 45% water and contains small amounts of an antifoam product

and a surfactant. He explained that triethylamine is used extensively in cosmetics and has an allowable level in food. He also explained that EDTA helps the product adjust to the hardness of the lake water. He confirmed that the ethanol was present at ~2% of the formulated product. Some of the other ingredients could contribute to the hazard of the product for pesticide applicators if direct skin or eye contact with the concentrated product occurs. The other ingredients listed do not pose a risk to the general public in contact with the diluted product. This is because the product is diluted in water more than 100,000–fold for control of Eurasian watermilfoil.

19. **Are there "gaps" in the data on triclopyr - things that we do not know the answers to?**

    There are often site-specific endangered animals or rare plants that have not been tested. To avoid impacts, the Washington Department of Ecology requires that the applicant check with the Department of Natural Resource's Heritage Program for rare plant locations and to consult the lists for animals. Because some salmon stocks are listed as threatened and endangered in the Pacific Northwest, the Washington Department of Ecology has also contracted with the University of Washington to conduct tests for potential sub-lethal effects on salmon with various herbicides.

20. **Are there any "unknown" risks to the use of triclopyr?**

    The world is full of potentially toxic substances and dangerous situations. However, separating the trivial and low level risks from the important environmental risks requires the application of sound scientific principles. Both the US EPA and the Washington Department of Ecology have examined the wealth of data and conducted risk assessments on triclopyr. They have both determined that triclopyr will have no significant acute or chronic impact on people, fish, or freshwater invertebrates when recommended rates are used.

21. **Is triclopyr one molecule away from Agent Orange?**

    The health effects of Agent Orange are linked to its dioxin contamination. Triclopyr does not contain toxic dioxin impurities so we do not need to be concerned about health effects of dioxins in the use of triclopyr.

    The molecule of triclopyr acid is structurally similar to the two herbicides in Agent Orange.

    - Agent Orange was an herbicide used extensively in the Vietnam war to defoliate large tracts of forest.
    - Agent Orange contained two active ingredients: 2,4-D and 2,4,5-T. Triclopyr acid is one atom different from 2,4,5-T and two atoms different from 2,4-D.
    - Triclopyr acid differs in an important feature. Triclopyr is based on a pyridine ring and 2,4,5-T is based on a phenol ring.

- This ring difference prevents dioxin impurities from forming during production of triclopyr.
- The principle health issue with Agent Orange was contamination with a highly toxic dioxin impurity (2,3,7,8- TCDD) formed during the synthesis of 2,4,5-T.
- Health effects observed in Airforce mixers, loaders, and sprayers; who experienced heavy occupational exposure to Agent Orange; have generally been ascribed to dioxin exposure.
- 2,4,5-T is now banned, largely because of unavoidable dioxin impurities formed during its production.
- Dioxin impurities do not occur in the synthesis of triclopyr because of the difference in the ring structure.
- There is no natural pathway for triclopyr to chemically convert to 2,4,5-T or form dioxins in the environment.

22. **How many of the triclopyr studies have been funded - in whole or in part - by Dow Chemical or one of its subsidiaries? What is the level of potential conflict of interest here?**

    Most of the studies required by EPA for the registration for triclopyr as an aquatic herbicide have been funded by its manufacturer. This is normal since companies typically spend 20-50 million dollars in testing to meet EPA registration requirements for aquatic herbicides. EPA has extremely rigorous testing standards called Good Laboratory Practices that the laboratories must comply with. This helps ensure quality results. Who else, besides the company selling the product would be willing to invest this sort of money in toxicity testing? However, government agencies and Universities often conduct their own field trials and other research and these published results are considered by the state when conducting risk assessments. For instance the University of Washington has published studies on using triclopyr to control purple loosestrife. The Washington Department of Ecology and the University of Washington are conducting research on the impacts of triclopyr (and other aquatic herbicides) on the smoltification of juvenile coho and chinook salmon.

23. **What does "half-life" mean and what is the "half-life" of triclopyr?**

    Half life is the period of time that must elapse for a pesticide to breakdown to ½ its original concentration. The half-life varies dependent upon where the triclopyr is found (i.e. water, hydrosoil, etc.) and other environmental factors. Half-lives for triclopyr and its breakdown products average six days or less in water and 8.4 days or less in sediment. (Citation: Letter to Kathleen Emmett, Dept. of Ecology, March 18, 2004: Comments on Environmental Impact Statement for Permitted Use of Triclopyr – Draft from Brian L. Bret, Ph.D.). Renovate 3™ has been shown to drop to non-detectable levels in 24 hours – 15 days (typically 3-7) based upon immunoassay testing completed during the 2003 field season.

24. **What does triclopyr "break down" into – are these elements harmful in any manner?**

Triclopyr's eventual, final metabolite is carbon dioxide (CO_2). To get there, it typically breaks down into trichloropyridinol or TCP, a compound that itself is far less stable than triclopyr in aquatic systems, as seen in aquatic field studies. TCP itself has a comparable level of toxicity as triclopyr and is frequently found at low concentrations in early sampling points in field studies. The methoxypyridine or TMP metabolite is rarely observed but also has a comparable level of toxicity as triclopyr and TCP.

25. **How long will the herbicide last in the lake water?**

In natural water, sunlight and microorganisms rapidly degrade triclopyr. Triclopyr concentrations decline sharply over the first several days after treatment. Residues should be more than 95% degraded and dissipated from treated water in 1-2 weeks following treatment with triclopyr.

26. **Will triclopyr, be found in the sediment of lakes after treatment?**

Renovate3™ degraded in the sediment in a relatively short period of time

27. **What are the impacts that triclopyr could have on ground water?**

The limited mobility of triclopyr in soil, low absorption constant, and high rate of microbial and photolytic degradation in water and sediment would indicate that this compound would have little potential for the extensive mobility required to contaminate groundwater supplies. This assumption is supported by data collected by the US Geological Survey (USGS), as this federal agency has collected over 850 groundwater samples over a five-year period in the Pacific Northwest area and these samples have been examined for pesticide residues. Triclopyr has never been detected in any of the groundwater samples taken by the USGS, despite extensive use as an herbicide in this region in forestry applications over a 20-year timeframe.

28. **What will be the positive impacts of utilizing triclopyr to control Eurasian watermilfoil?**

Triclopyr (Renovate 3™) is selective to broad-leaved submersed aquatic plants such as Eurasian watermilfoil. Many native aquatic plants are not broad-leaved and are not significantly impacted by triclopyr. Significant reduction of Eurasian watermilfoil is a key component of improving and restoring the native aquatic plant community. If native species have less Eurasian watermilfoil to compete with they recover. There are additional benefits to the organisms that utilize these native species for food or shelter with the reduction of the Eurasian watermilfoil.

29. **What are the risks associated with a "Do Nothing Alternative" in lakes with Eurasian watermilfoil?**

Eurasian watermilfoil generally dominates the ecosystem to depths up to 20 feet (depending on the light conditions) and out-competes native submersed aquatic vegetation. The diversity of the aquatic vegetation community generally declines in Eurasian watermilfoil infested water bodies and this impacts the entire community within the lake. A plant such as Eurasian watermilfoil invades takes over and becomes a *keystone* species in a foreign environment/ecosystem. This changes and has negative impacts on the entire ecosystem.

30. **How can triclopyr kill only the milfoil and not other plants?**

Broad-leaf plants (dicots) have different biochemistry than monocots. Triclopyr affects the family of broad-leafed plants or dicots. Eurasian watermilfoil is a broad-leaf plant whereas most native aquatic plants are monocots and not susceptible to triclopyr.

31. **Is triclopyr a long term solution - or a short term fix?**

Eurasian watermilfoil is extremely difficult to eradiate. If diver hand pulling of Eurasian watermilfoil can be successfully accomplished in the water body after the triclopyr treatment to remove remaining milfoil, then the triclopyr treatment could offer some long-term results.

32. How will the die off of Eurasian watermilfoil plants in lakes after triclopyr treatment impact the lake?

Eurasian watermilfoil plants will slowly exhibit symptoms of herbicide damage (twisting of the stems due to the plant hormone (auxin-like) effect of triclopyr). The plants will gradually sink to the lake bottom and decompose. Systemic herbicides generally take a week to several weeks to entirely kill the plants so that you don't tend to get severe oxygen depletion that can sometimes occur when using contact herbicides. Native plants will fill in the areas left unoccupied by Eurasian watermilfoil.

33. **Are there any species "at risk" with the use of triclopyr?**

Broad-leaf aquatic plants, such as Eurasian watermilfoil, will be affected by triclopyr.

34. **Where else has triclopyr been used? Were any problems encountered with these applications – to the environment, fish, wildlife etc.?**

Renovate 3™ was labeled for use by the EPA in November of 2002. Prior to this triclopyr it had been used under an Experimental Use Permit as an aquatic herbicide since 1988 (for small test plots around the country). Additional field trials have been completed by researchers since 1984). A number of scientific papers by independent researchers have been published about field studies including studies in the Pend Oreille

River, Washington, and Lake Minnetonka Minnesota. Triclopyr has also been used for purple loosestrife control in Washington. In 2003 (Renovate 3™'s first field season after EPA registration) it was used in 27 states on hundreds of projects. There have not been any reported problems encountered with these applications.

35. **Is it true that some native plants take over a year to recover from an application of triclopyr?**

Triclopyr is a selective herbicide which means that it generally targets the broad-leaved aquatic plants. Although there are few aquatic broad-leaved plants, there are others beside Eurasian watermilfoil. These species could be expected to be impacted by triclopyr. Eurasian watermilfoil is not thought to have viable seeds or other reproductive structures (besides fragments), whereas native aquatic plants have seeds, and sometimes tubers and other over-wintering structures. Even if the mature native plants are impacted by triclopyr, these plants should recover from their seeds or tubers the next season. Triclopyr treatment should enhance native plant growth since Eurasian watermilfoil crowds out native species. Removing Eurasian watermilfoil opens up niches that native species will fill. A study done in the the Pend Oreille River by the US Army Corps of Engineers with triclopyr documented that removing Eurasian watermilfoil markedly enhanced native plant growth in the treated areas.

36. **Can milfoil plants develop immunity to triclopyr?**

Short-term and long-term data collected by the U.S. Corps of Engineers Aquatic Plant Control Research Program (Vicksburg, MS) has not demonstrated that Eurasian watermilfoil is capable of developing immunity or "resistance" to triclopyr's mode of action. Work conducted by Dr. Kurt Getsinger and others with the Corps of Engineers indicates that "*control of this species is likely*" with appropriate dose regimes of triclopyr, which generally range from 0.5 to 2.5 ppm. The Corps of Engineers is particularly interested in the use of triclopyr to control milfoil for maintenance of waterways, as "*this herbicide shows a low order of toxicity to microbial communities and higher aquatic organisms and residue accumulation in sediment, shellfish, and fish is negligible**".

*Netherland, M. and Getsinger, K. 1992. Efficacy of triclopyr on Eurasian watermilfoil: Concentration and exposure time effects. J. Aquatic Plant Management 30: 1-5.

APPENDIX D GROUND WATER MONITORING PROTOCOLS (ECOLOGY)

Ground water monitoring protocol for in-lake applications of triclopyr

NOTE: This protocol shall be used if a permittee is applying triclopyr for the third time in a three year period (for submersed or floating-leaved plant eradication or control).

3 – 6 months prior to planned treatment

1. Identify all relevant wells within the county inventory within ¼ mile of the treatment area.
2. Choose at least one non-artesian well within ¼ mile of the treatment area to be the monitored well.
3. The well should be located within the hydrological path of the water body to be treated (for example, if the hydrology shows that any groundwater in an area is moving southwest, choose a well within ¼ mile southwest of your treatment area.
4. The well chosen should be no more than 50 feet deep (if no wells are available at this depth, no sampling is required).
5. Contract with a lab accredited through the Department of Ecology for triclopyr and TCP (triclopyr's breakdown product).

1 – 2 weeks prior to treatment

Follow laboratory protocols when taking a baseline water sample to be analyzed for triclopyr and TCP.

1 month after treatment

Follow laboratory protocols when taking a post-treatment water sample to be analyzed for triclopyr and TCP.

Prior to November 30th of the treatment year, report sampling results to Ecology as part of the annual report described in Special Condition S9.

APPENDIX E NOTIFICATION AND POSTING REQUIREMENTS (ECOLOGY)

S6. NOTIFICATION AND POSTING REQUIREMENTS

A. Ecology Notification Requirements

1. Pre- and post-treatment notification – For every week that treatment is planned, the Permittee(s) shall email information to Ecology on the form supplied in Appendix D. This form shall list the water bodies scheduled for treatment the following week. This form shall also detail the treatments that have taken place during the current week. The Permittee shall send the email to the appropriate Ecology regional office and Ecology headquarters no later than 5:00 pm on Friday of each week during the treatment season.

Central Regional Office, Yakima	(509) 575-2490	email: rlat461@ecy.wa.gov
Eastern Regional Office, Spokane	(509) 329-3400	email: kmer461@ecy.wa.gov
Northwest Regional Office, Bellevue	(425) 649-7000	email: tsho461@ecy.wa.gov
Southwest Regional Office, Lacey	(360) 407-6300	email: mhil461@ecy.wa.gov
Water Quality Headquarters, Lacey	(360) 407-6400	email: kelm461@ecy.wa.gov

2. Inspection Coordination Requirements

   a. At Ecology's request, each Permittee shall coordinate and schedule inspections with the appropriate Ecology regional staff.

   b. The agreed upon location and starting time for the inspection shall be on record in writing at Ecology.

   c. For inspections scheduled by the Ecology regional staff in Condition S6.A.2.a., the Permittee shall not treat unless Ecology staff are present or do not appear within 30 minutes of the scheduled and agreed upon start time, at the scheduled and agreed upon location.

3. The Permittee shall immediately notify the appropriate Ecology regional office if a spill of product(s) covered under this permit occurs into waters of the state, or onto land with a potential for entry into waters of the state. The Permittee shall notify the appropriate Ecology regional office when they are made aware of any of the following conditions occurring during or after a treatment:

   a. Any person(s) exhibits or indicates any toxic and/or allergic response as a result of the treatment.

   b. Any fish or fauna exhibit stress conditions or die within or downstream of the treatment area.

3. If the Residential and Business Notice explains the chemical **application schedule** for the whole season, and there is no deviation from that plan, no further Residential and Business Notice will be required for the rest of the season (unless a resident or business specifically requests further notification).

C. Camp Notification Requirements

1. Camps shall notify parents/guardians of campers in writing if a pesticide application is expected to occur during or within two weeks prior to their camper attending camp.

2. The written notification shall include:

   a. The name of the product being applied,

   b. The time period during which the treatment will occur,

   c. Any swimming or recreational advisories or restrictions as named in this permit or on the product label, and

   d. Camp contact information for further questions.

D. Posting Requirements

1. The Permittee shall post signs no more than 48 hours prior to the application of any products covered under this permit. (The Permittee shall use templates provided in Appendix F). No modifications of this template are allowed, except where Ecology has requested that the Permittee fill in label restrictions about the pesticide to be used.

2. The Permittee shall ensure that posted signs remain in place until the end of the period of water use restrictions.

3. The Permittee shall remove all old signs before a new treatment begins or before the end of the treatment season, whichever comes first.

4. The Permittee shall post warning signs in English and in the language commonly spoken by the community that uses the area.

5. Posting Privately or Publicly-Owned Shoreline Areas (excluding public access areas)

   a. The Permittee shall post **privately or publicly-owned shorelines** using the templates provided in Appendix F. No modifications of this template are allowed, except where Ecology has requested that the Permittee fill in label restrictions about the pesticide to be used.

b. For those applications containing a publicly accessible area,

   i. Post signs no more than 48 hours prior to an application

   ii. Place signs within 25 feet of any shoreline facing both egress and entrance of any boat launch on the water body that is within ½ mile of any treatment site. Boat launches also include sites commonly used as put-ins and take-outs for small, non-trailered watercraft. Check the Washington State Parks and Recreation Commission publication Public Boating Facilities in Washington State, second edition, 1988, to identify public accesses. Reference copies of this publication are available through the Washington State Library, King County Library, Gonzaga University Library, and Washington State University Library.

c. The Permittee(s) shall use good faith and reasonable effort to ensure that posted signs are secured and remain in place.

d. The Permittee shall post signs so they are secure from the normal effects of weather and water currents, but cause no damage to private or public property.

e. The Permittee is responsible for removal of all signs at the end of the treatment season. Biodegradable sign material may be used so that removal is not necessary.

f. The Permittee shall post signs in English and the language, if other than English, commonly spoken by the community that uses the area.

8. Posting on the Water

   a. The Permittee shall post buoys on the water when any of the following conditions are met for the treatment of submersed, floating, or floating-leaved plants:

      i. The product has recreational and/or fish consumption restrictions,

      ii. The water body is greater than one acre and/or more than 200 feet from the treatment area to the opposite shore, or

      iii. The entire shoreline has not been posted.

   b. Posted buoys shall have:

      i. Durable weather-resistant signs

      ii. Signs readable from two opposing directions

      iii. Signs positioned so they are completely out of the water

APPENDIX F PUBLIC NOTICE TEMPLATES (ECOLOGY)

The public notice must be published at least ***once*** each week for ***two*** consecutive weeks, in a ***single*** newspaper of general circulation in the county in which the chemical treatment is to take place.

Note: Submit the NOI and public notice to Ecology before the date of the first public notice.

Public Notice Template

_____ (Applicator or Government entity) (Phone number)_____ is seeking coverage under the NPDES Waste Discharge General Permit for aquatic plant and algae management.

(Lake Name)_____ (Acres) _____ Applicant_____ Location _____

(Lake Name)_____may be treated to control aquatic weeds and algae growth between (date) _____through (date) _____. The chemicals planned for use are: _____, _____, _____, _____, ... The total treatment area will not exceed ____acres.

The following information shall be included in the legal notice.

Any person desiring to present their views to the Department of Ecology regarding this application shall do so in writing within 30 days of the last date of publication of this notice. Comments can also be submitted on the SEPA documents for this project. Submit comments to: Department of Ecology, P.O. Box 47696, Olympia, WA 98504-7696, Attn: Water Quality Program, Aquatic Pesticide Permit Coordinator.

Any water use restrictions and or advisories will be posted near the treatment areas along the private shoreline and public access points. Copies of the application are available by calling the Water Quality Program, Aquatic Pesticide Permit Coordinator at _____.

DEPARTMENT OF ECOLOGY

Aquatic Treatment Email Form

Email to: _____

From: Company: _____

Cell Phone No: _____

Pre-Treatment Notification

Week of Treatment: _____

Water body name	County	Location where treatment will begin	Chemicals/products proposed for use	Targeted plants & algae	Proposed date & treatment start time

Additional Information: _____

Herbicide Treatment

Business and Residential Notice

Distribution Date: _____

_____ will be treated with the aquatic herbicide(s)/algaecide(s) on/or between _____.

Product(s) planned for use: _____

Active ingredient(s): _____

Location of Treatment(s):

_____

Treated and potentially affected areas will be sign posted the day of application. The signs will describe any water use restrictions or advisories.

If you are withdrawing water for potable or domestic water use, livestock watering, or irrigation, and have no alternate water source, please contact the applicator (name)_____ at ( ) _____or (e-mail) _____ to arrange an alternate water supply.

If you would like to request additional notification prior to treatment, or have further questions, please contact me using the information above.

This herbicide treatment is regulated under a permit issued by the Washington State Department of Ecology.

CAUTION

Fluridone (1-methyl-3-phenyl-5-[3-(trifluoromethyl) phenyl]-4(1H)- pyridinone) will be applied under permit to these waters on _____ to control aquatic vegetation.

There are no swimming or recreation restrictions or advisories when using this product.

Applicator to put additional label restrictions or advisories here:

Potable Water Restrictions:

Irrigation Restrictions:

Fishing Restrictions:

Stock Watering Restrictions:

For more information contact the applicator: _____
Phone number: (___)_____

Or the Department of Ecology at (___) _____

THIS SIGN SHALL REMAIN IN PLACE UNTIL 2 DAYS AFTER APPLICATION

CAUTION

Triclopyr TEA (Triethylamine salt of 3,5,6-trichloro-2-pyridyloxyacetic acid) will be applied under permit to these waters on _____ to control aquatic vegetation.

It has been advised that no swimming occur within the treated area during or for 12 hours following treatment.

Applicator to put additional label restrictions or advisories here:

Potable Water Restrictions:

Irrigation Restrictions:

Fishing Restrictions:

Stock Watering Restrictions:

For more information contact the applicator: _____

Phone number: (___) _____

Or the Department of Ecology at (___) _____

THIS SIGN SHALL REMAIN IN PLACE UNTIL 2 DAYS AFTER APPLICATION.

CAUTION

Diquat (Dibromide of 6, 7-dihydrodipyride (1,2-a:2',1"-c) pyrazinediium) will be applied under permit to these waters on _____ to control aquatic vegetation.

Use advisories: It has been advised that no swimming occur within the treated area during or for 24 hours following treatment.

Applicator to put additional label restrictions or advisories here:

Potable Water Restrictions:

Irrigation Restrictions:

Fishing Restrictions:

Stock Watering Restrictions:

For more information contact the applicator: _____
Phone number: (___) _____

Or the Department of Ecology at (___) _____

THIS SIGN SHALL REMAIN IN PLACE UNTIL 2 DAYS AFTER APPLICATION

Post-Treatment Notification

Week of Treatment: _____

Water body name	County	Chemicals/products used	Targeted plants & algae	Acres treated	Amount of product applied (lbs. or gallons)	Date treatment occurred

Additional Information: _____

Knowingly submitting false information shall result in permit termination.