Lake Kilarney Integrated Aquatic Plant Management Plan

March 1997

ENVIROVISION

WASHINGTON STATE DEPARTMENT OF ECOLOGY

LAKE KILLARNEY
INTEGRATED AQUATIC PLANT MANAGEMENT PLAN

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Prepared By:

ENVIROVISION
1339 Quince Street
Olympia, WA 98506

in association with
Resource Management, Inc.

Prepared for:

King County Water & Land Resources Division
and Lake Killarney Improvement Association

This project was funded in part by
Washington State Department of Ecology and
King County Department of Natural Resources.

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State agency staff also attended meetings and provided technical guidance. These included Kathy Hamel, Washington State Dept. of Ecology (WDOE), Bob Pfeifer, Washington State Dept. of Fish & Wildlife (WDFW), and Mary Kautz (WDOE).

Last, Resource Management Inc. performed aquatic plant surveys, provided mapping and graphics support and most important, provided assistance with selection of alternatives and detailed application and cost information.

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PROJECT OVERVIEW

Lake Killarney is located in south King County near the City of Federal Way, Washington. It is a small lake (37 acres) that is quite shallow (maximum water depth of approximately 15 feet or 4.5 meters). It is moderately productive in terms of phosphorus concentrations and has been rated as mesotrophic. No streams flow into Lake Killarney; a wetland located along the northern boundary likely serves as a water source during certain periods of the year. Otherwise, groundwater and precipitation/runoff are the only sources of incoming water. A surface outflow exits the lake to the south and forms an unnamed tributary, that flows eventually into Hylebos Creek. Currently, the lake has a small public access site owned by the Washington State Department of Fish and Wildlife. The City of Federal Way has recently purchased 10.8 acres of land on Lake Killarney that has been dedicated for development of a passive park.

Aquatic plants, especially Eurasian Watermilfoil (*Myriophyllum spicatum*) and White Water Lily (*Nymphaea odorata*), first became a problem in the lake in the mid-1970s. Lake residents' concerns about the plant populations resulted in establishing the Lake Killarney Improvement Association (LKIA) whose main function has been to collect funds for completing herbicide applications of the lake to control both aquatic macrophytes and algae. Herbicides were first applied to the lake in 1979. Since 1987, the LKIA (through a licensed applicator) has applied either Sonar® for control of submersed plants, or Rodeo® for control of waterlilies in addition to annual and sometimes twice annual applications of copper sulfate to control algae. More recently, Purple Loosestrife has colonized nearshore areas and lake residents have organized annual events for gathering volunteers to handpull and remove the plants from the shoreline.

In 1993, lake residents and King County Surface Water Management (KCSWM) joined together to apply for a grant to develop a more integrated plan for providing long-term control of aquatic plants that does not rely entirely on chemical controls for treating problem plant populations. KCSWM was awarded a grant for development of an Integrated Aquatic Vegetation Management Plan (IAVMP). This report provides a description of the aquatic plant control plan developed for the lake and summarizes the steps taken in development of the plan.

The basic recommendations selected for aquatic plant control in Lake Killarney are:

- Stock sterile (non-reproducing) Grass Carp in the lake to consume submerged plants.
- Use herbicides once every three years to control the extent of the existing floating-leaved plant beds (Watershield and Water Lily).
- Provide some hand or small boat operated cutting tools to give lakeside residents the ability to maintain their nearshore area.

- Continue with annual Purple Loosestrife removal events either until all of the plants are removed, or until the population expands to a point where it is necessary to use chemicals to eradicate the population.
- Set up an Aquatic Plant Advisory Committee for the lake whose function is to make decisions about controls needed (e.g. Loosestrife approach) and goals attainment.

PUBLIC INVOLVEMENT

Public involvement for this project has included steering committee meetings, public meetings, volunteer Purple Loosestrife removal events, and production of a handbook. Each is described below.

The Lake Killarney Steering Committee was set up in March 1995 to guide the development of an Integrated Aquatic Plant Management Plan for Lake Killarney. Nine meetings have been held in a 19-month period, from March 1995 to October 1996. During this time, the steering committee completed the problem statement, identified and developed management goals, organized the public meeting, coordinated two Purple Loosestrife removal events, and selected aquatic plant control alternatives.

The following are members of the steering committee: Joanne Davis and Bob Storer of King County Surface Water Management; Paul Desjardin, Bonnie Anderson, Gerri Baldwin, Gary Bullard, Jerry Cloud, Rod Danz, Dennis Dunn, Kjell Feroy, Norman Fiess, Dee Gordon, Linda Irwin, Kory Keath, Craig Rice, Mike Stevenson, and John Wilcox of the Lake Killarney Improvement Association; Jon Jainga and Dave Renstrom of the City of Federal Way; Vicki Kirchner of World Vision; Gary Hyde of Lake Geneva; and Lynn Claudon of Weyerhaeuser.

A public meeting sponsored by the King County Surface Water Management Division and the Lake Killarney Steering Committee was held on August 24, 1995. The purpose of this meeting was to provide background information about Lake Killarney, present the problem statement and management goals drafted by the steering committee, and seek comments and questions from the public. A second public meeting is planned to present the draft plan and invite comments from the public.

Over 50 volunteers worked together on June 24, 1995 to pull up invasive Purple Loosestrife from the shores of Lake Killarney. More than 100 bags were filled with the noxious weed. A second event was held in the spring of 1996. According to some of the volunteers, there was much less plant matter removed in 1996 compared to 1995. However, it was unclear whether this was due to a decrease in the number of plants or a decrease in the size of the plants removed.

Members of the "Lake Killarney Improvement Association" also produced a handbook describing how to conduct an aquatic plant survey, for use by other lake communities. A copy of this manual is included as Appendix C.

LAKE AND WATERSHED CHARACTERISTICS

Watershed Characteristics

Lake Killarney and its watershed are located in the southernmost portion of King County. A part of the watershed, including a substantial section of shoreline, lies within the boundaries of the City of Federal Way. The 203 acre watershed drains a gently sloping topographic area. The lake and associated wetlands form the headwaters of an intermittently flowing stream that becomes Hylebos Creek. Hylebos Creek flows south and west into the Hylebos Waterway in the City of Tacoma, which discharges to Commencement Bay. While the majority of this part of south King County and northern Pierce County is already developed as commercial/residential, Lake Killarney and its watershed are still relatively wooded and the residential areas are largely single-family homes on larger suburban size lots.

The Lake Killarney watershed is considered part of the East Branch of the Hylebos Basin. Since the 1950s, population growth in the Hylebos Basin planning area has outpaced most other communities in King County. The fact that several state highways are located in the area has stimulated a high growth rate and the current land-use pattern (King County Surface Water Management, 1991). Fortunately for the lake, most of the development, especially commercial development, has occurred west of the lake. The land use information for 1987 indicated that approximately 50% of the shoreline was contained in rural/undeveloped land use. The remaining 50% was in high density single-family use.

Predictions of full build-out conditions continue to show commercial development occurring to the west of the lake (King County Surface Water Management, 1991). However, the rural/undeveloped land is expected to become either high density single-family or multi-family homes except where purchase has occurred of 10 and 11 acre tracts by World Vision Corporation and the City of Federal Way, respectively. These tracts are located in the area that was designated as multi-family.

Significant changes in land use can be expected in the project area in the near future because the watershed is comparatively undeveloped for the area. Fortunately, a large percentage of the shoreline area itself is already owned and protected by corporations and the City of Federal Way. It has been estimated that almost 30% of the shoreline is contained within these public/corporate parcels that are not likely to be developed any further. Wetlands in the watershed are primarily limited to the perimeter wetland that surrounds the northern half of Lake Killarney.

Lake Characteristics

Lake Killarney is a 37 acre lake located in southern King County, Washington. About one third of the shoreline lies within the City of Federal Way, and the majority lies within unincorporated King County (Figure 1). The lake is quite shallow with a mean and

maximum depth of 2.5 m (8.2 ft.) and 4.5 m (14.8 ft.), respectively. There is no distinct surface water inflow to Lake Killarney. Runoff from the watershed enters the lake primarily through stormwater drains (Storer, B. Personal Communication). The wetland located along the north shore likely acts as both a source and sink of water depending upon the season and groundwater conditions. The lake is divided into two distinct basins, the north basin is smaller and shallower (average depth of 4 feet), as compared to the south basin (average depth 6 feet). The total volume of water in the lake has been estimated at 187 ac-ft, the majority of this (161 ac-ft or 86%) is held within the south basin. Physical characteristics of Lake Killarney are summarized in Table 1.

Outflow from the lake generally occurs only during the wet season (November through June). The lake outlet is in the southwestern corner of the lake through a small concrete culvert.

Currently public access is provided by a small boat launch owned by the Washington Department of Fish and Wildlife (WDFW). The City of Federal Way has recently purchased 10.82 acres of land and is in the process of forming a plan for its development as a passive recreational use park.

Table 1. Physical characteristics of Lake Killarney and its watershed.

Characteristic	English Units	Metric Units
Watershed area	203 acres	82.2 hectares
Surface area	37 acres	15.0 hectares
Lake volume	187 ac-ft	
Maximum depth	14.8 feet	4.5 meters
Mean depth	8.2 feet	2.5 meters
Shoreline length	10,305 feet	3,141 meters

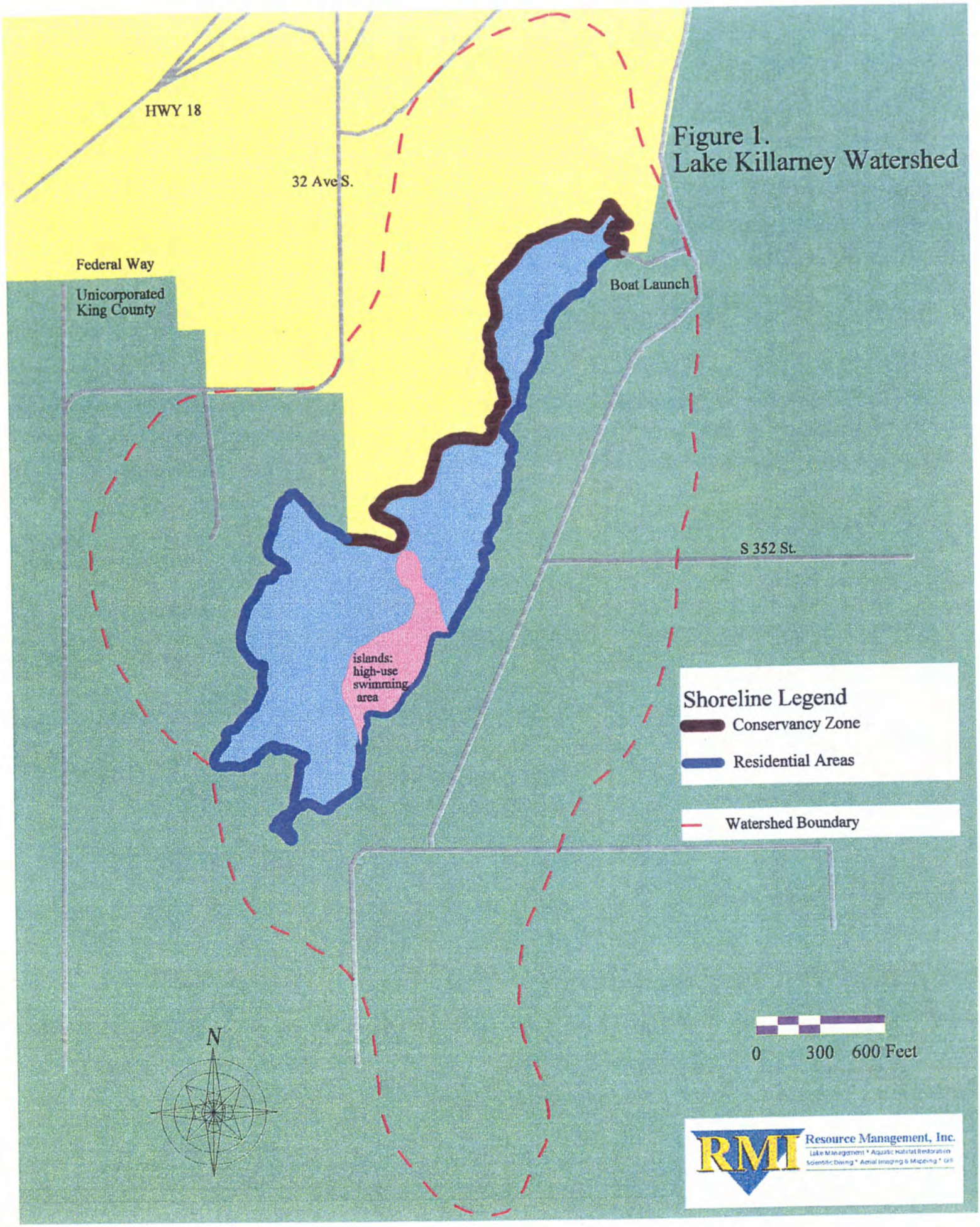
Figure 1.
Lake Killarney Watershed
HWY 18
32 Ave S.
Federal Way
Unicorporated
King County
Boat Launch
S 352 St.
islands:
high-use
swimming
area
Shoreline Legend
Conservancy Zone
Residential Areas
Watershed Boundary
N
0 300 600 Feet
RMI
Resource Management, Inc.

Water Quality

The former Municipality of Metropolitan Seattle (Metro) began monitoring Lake Killarney in 1989. The most recent complete data sets are contained in the King County Lake Volunteer Monitoring Report 1993-1995. These were used to create the data summary in Table 2. The lake is characterized by high phosphorus concentrations, high chlorophyll levels, and low transparency. Summer period total phosphorus concentrations have ranged from February - October total phosphorous concentrations have ranged from 25-50 ug/L.

The waters of Lake Killarney are naturally highly colored due to the effects of the wetland that comprises the northern shoreline. Summer period transparency, as measured by Secchi disk depth, averaged just over two meters (Table 2). The low transparencies measured are a result of the colored nature of the water in addition to the effects caused by algae blooms.

The most common way lakes are classified is by their trophic state, which defines a lake in relation to the degree of biological productivity. Lakes with low nutrients, low algae levels, and clear water are classified as nutrient poor or "oligotrophic". Lakes with high nutrients, high algae levels, and low water clarity are classified as nutrient rich or "eutrophic". "Mesotrophic" lakes have water quality characteristics between these two classifications. "Eutrophication" is the term used to describe the process of lake aging, where lakes progress from oligotrophic to eutrophic conditions. Although eutrophication is a natural process that occurs slowly over time, it can be greatly accelerated by human activities in a watershed. Classifying a lake based on trophic level indicators is a useful way to describe gross changes in a lakes' water quality over time.

Total phosphorus, chlorophyll *a*, and transparency are the three water quality parameters most often used to rate the overall trophic condition of a lake. Threshold values for trophic state used to determine the overall condition of small lakes monitored in King County are presented in Table 2, along with a summary of the Lake Killarney data.

Table 2. Trophic State Classification.

Trophic State[1]	Total Phosphorus (µg/L)	Chlorophyll *a* (µg/L)	Transparency (meters)
Oligotrophic	< 10	< 4	> 5
Mesotrophic	10-20	4 - 10	2-5
Eutrophic	>20	>10	<2
Killarney (Range)[2]	25-50	0.5-12.0	2.0-3.0
Mean (# of years)	36 (n=2)	5.1 (n=2)	2.7 (n=2)

[1] Source: Vollenweider, R.A. 1970.
[2] Range shown is range of arithmetic means from spring, summer, and fall sampling during the years 1994 and 1995.

Based on the measured values of phosphorus, chlorophyll *a*, and transparency, Lake Killarney can be classified as mesotrophic or moderately nutrient enriched in terms of chlorophyll and transparency data, but eutrophic or enriched in terms of phosphorus concentrations.

There are only a few stormwater discharges to Lake Killarney (B. Storer, Personal Communication. 9 July 1996), thus the primary external source of phosphorus and other nutrients appears to be surface runoff from adjacent properties and input from the wetland. Failing septic systems are also a suspected source of pollutants such as nutrients and bacteria to Lake Killarney. Septic type odors have been occasionally reported by lake residents.

In the past the lake has experienced frequent, heavy algae blooms. Copper sulfate has often been applied to the lake at least once and sometimes twice during the summer to control these blooms. Given the high phosphorus concentrations measured in the lake, algae blooms can be expected to continue, especially if large aquatic plant populations are retained at their current low level.

Sediment samples were collected from Lake Killarney in July of 1995 and analyzed for total phosphorus (TP), copper, and total nitrogen (TKN). It is not the purpose of this report to perform a detailed analysis of these results. The main concern in terms of future herbicide or copper sulfate applications is with the copper concentrations. Copper concentrations ranged from 57 to 355 mg/Kg in the top 2 centimeters of sediment to 25 to 292 mg/Kg in the sediments located from 2 to 12 centimeters below the surface. The average concentration was 145 mg/Kg. Sixty percent of the samples (12 out of a total of 20) had concentrations that exceeded the "severe effect level" (the concentration which caused detrimental affect to the majority of sediment-dwelling organisms) of 110 mg/Kg set by the Ontario Ministry (Persuad, D. 1991), and 85% exceeded the level considered to represent heavily polluted conditions (>75 mg/Kg) by the USEPA (USEPA, 1977).

These elevated copper concentrations indicate accumulation from the many copper sulfate treatments of the lake. The sediment concentrations can be expected to continue to increase with continued use of copper sulfate. In addition to the probable impact this will have on sediment-dwelling organisms, it may also cause disposal problems in the future if sediments need to be removed.

Fish and Wildlife Community

Lake Killarney is managed by the Washington Department of Fish and Wildlife (WDFW) as a trout and warm-water fishery. The existing warm water fishery consists of Largemouth Bass (*Micropterus salmoides*), Yellow Perch (*Perca flavescens*), Bluegill (*Lepomis macrochirus*), Brown Bullhead (*Ictalurus melas*), and Black Crappie (*Pomoxis nigromaculatus*). This fishery is augmented by stocking with trout. Since at least 1954 WDFW has been stocking approximately 2,000 catchable size Rainbow Trout (*Salmo gairdneri*) in the lake each spring. Currently, WDFW is reviewing its management strategy for this lake and is considering managing it as a warm-water fishery only (Pfeifer, R. 1996, Personal Communication).

Aquatic Plant Community

The aquatic plant community in Lake Killarney was surveyed by King County SWM staff in July of 1995. The survey included a mapping inventory to map extent of plant beds and species and collection of biomass samples along 13 transects to determine plant biomass. The lake was also surveyed by boat during August of 1996. Figure 2 summarizes the aquatic plant community as observed during the more recent survey. Both surveys are discussed below.

In 1995, the macroalgae (*Nitella* sp. and *Chara* sp.) comprised the large majority of the submerged plant population. The large stand of Water lilies and Watershield comprised the only other significant plant type. *Nitella* and *Chara* typically grow in dense stands between depths of 1 and 15 feet, but do not grow taller than 2-5 feet. Consequently, these plants are considered to be beneficial since they occupy plant habitat that could otherwise be inhabited by taller, thicker, more noxious plants. Other submerged plants observed in the lake during the 1995 survey included three different species of pondweeds, Quillwort (*Isoetes* sp.), and Bladderwort (*Utricularia* sp.). It is also possible that there was some Eurasian Watermilfoil (*Myriophyllum spicatum*) in the lake. However, positive confirmation of plant presence and location could not be made during follow-up surveys.

Much of the northwestern shoreline of Lake Killarney was characterized by a large, dense population of floating-leaved vegetation, primarily comprised of Watershield (*Brasenia schreberi*) but also containing waterlilies, and Duck Weed (*Lemna* spp.). These extended to approximately the 5 foot depth contour. A shallow embayment located in the northwest portion of the south arm of the lake also contained a few large patches of lilies and there were a few small patches distributed along the remaining shoreline. During the 1995 survey there was little diversity observed in the submerged macrophyte community, probably as a result of the history of herbicide applications. (Vegetation dominated by *Chara* and *Nitella* is typical for sonar-treated lake. (K. Hamel, WDOE, Personal Communication.))

Biomass measurements of the submerged and floating-leaved communities were taken during the 1995 survey. These showed a range in values of 39 g/m^2 to 906 g/m^2 with a mean value of 208 g/m^2. The areas with the highest biomass were generally located in the northwestern portion of the lake and reflect the large amount of biomass contained within the expansive watershield/waterlily beds. Comparisons can be made with other King County lakes for which there are similar data. Mean biomass estimates were similar to those measured in Lake Sawyer (approximately 275 g/m^2), and Lake Desire (approximately 175 g/m^2), but significantly higher than those measured at Lake Twelve (less than 50 g/m^2).

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Biomass measurements of the submerged and floating-leaved communities were taken during the 1995 survey. These showed a range in values of 39 g/m^2 to 906 g/m^2 with a mean value of 206 g/m^2. The areas with the highest biomass were generally located in the northwestern portion of the lake and reflect the large amount of biomass contained within the expansive watershield/waterlily beds. Comparisons can be made with other King County lakes for which there are similar data. Mean biomass estimates were similar to those measured in Lake Sawyer (approximately 275 g/m^2), and Lake Desire (approximately 175 g/m^2), but significantly higher than those measured at Lake Twelve (less than 50 g/m^2).

Figure 2. Lake Killarney
Aquatic Plant Communities
August 1996
North Arm

Aquatic macrophyte data
from boat survey 8/1/96

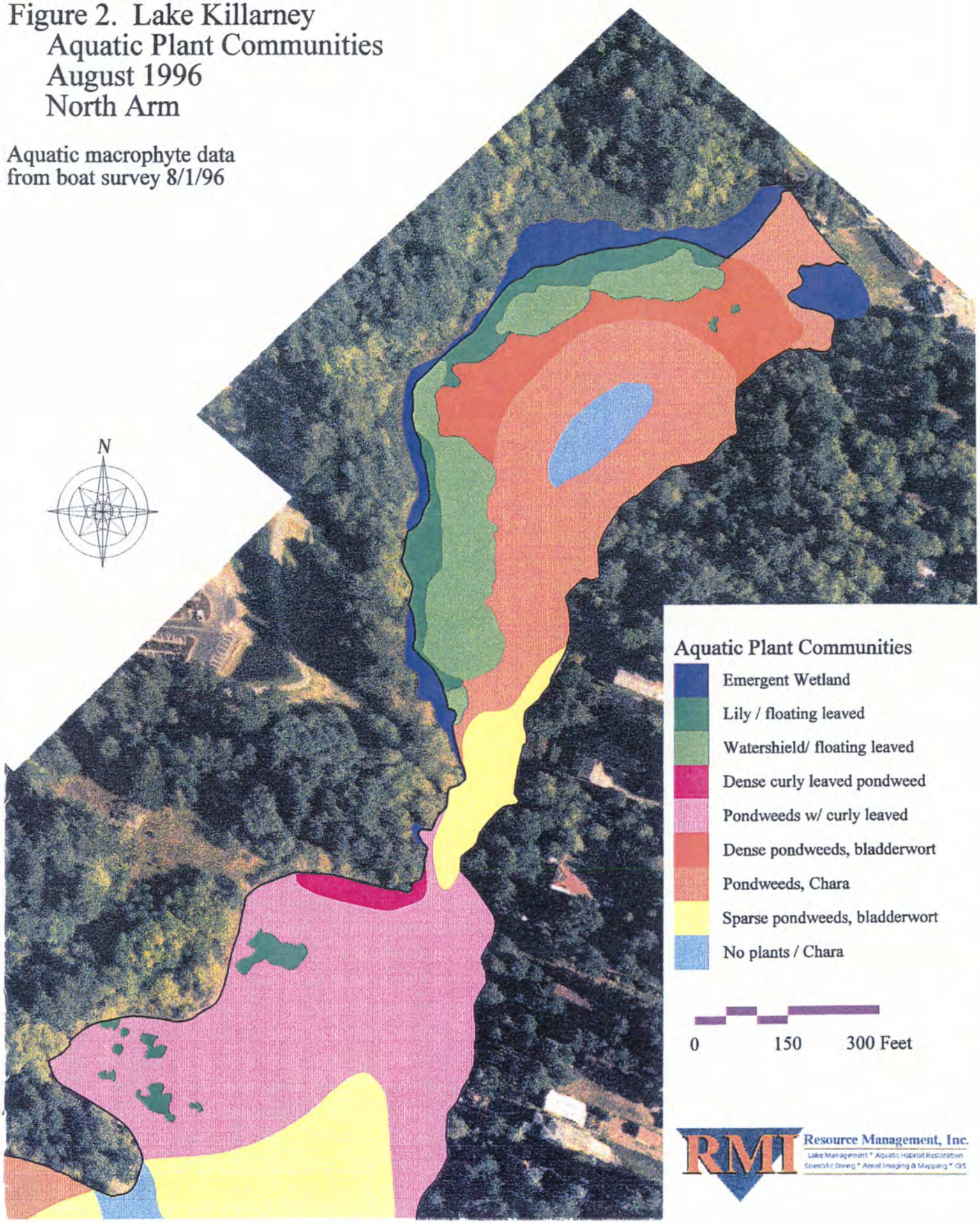
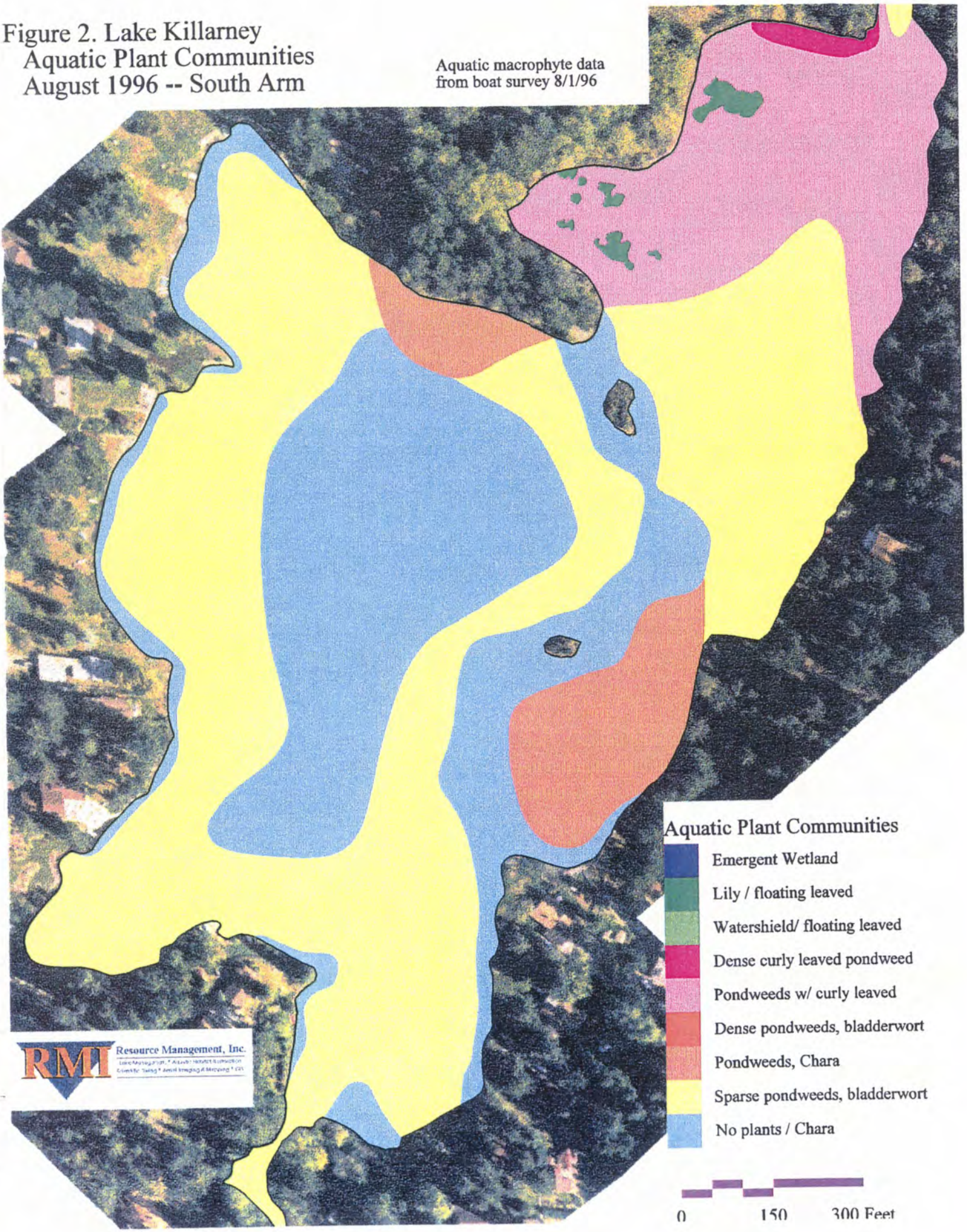


Figure 2. Lake Killarney
Aquatic Plant Communities
August 1996 -- South Arm

Aquatic macrophyte data
from boat survey 8/1/96



Emergent vegetation is found primarily along the northwestern shoreline corresponding to the shoreline area that has not been developed and remains in its largely natural state. Emergent vegetation species observed include: Yellow Iris (*Iris pseudacorus*), Rush (*Juncus* sp.), False Loosestrife (*Ludwiga palustrus*), Marsh Cinquefoil (*Potentilla palustris*), Burreed (*Sparganium emersum*), Hardhack (*Spiraea douglasii*), Cattail (*Typha latifolia*), and Purple Loosestrife (*Lythrum salicaria*). The highly invasive Purple Loosestrife has been found around the entire lake shoreline. The citizens of Lake Killarney have recognized the threat this plant creates to their environment and have now completed two volunteer events for hand removing the plant. These events occurred during the spring of 1995 and 1996. A long-term strategy for eradication of this riparian zone plant is also included as part of this plan.

In 1986 when Lake Killarney was first treated with fluridone in the form of Sonar pellets, Eurasian Watermilfoil occupied almost the entire lake with only 15-20% of the lake area not containing plants that grew all the way to the lake surface (T. McNabb. Personal Communication. 8 July 1996.) No Eurasian Watermilfoil was observed in the lake during either the 1994 or 1995 surveys, however, a plant fragment was found amongst the 1995 samples when they were returned to the lab. Because the plant population was continuing to evolve in the absence of herbicide treatments (for the past two years) and to confirm the presence or absence of Eurasian Watermilfoil, another plant survey was completed in August of 1996 to assist the analysis for a long-term management plan.

Results of the August 1996 survey indicated that the submerged plant community had changed both in terms of plant types and densities from the 1995 results. There was significantly less macroalgae and increased pondweeds. The floating-leaved plant community had not exhibited significant change. The submerged plant bed in 1996 was largely comprised of pondweeds including a few types of the thin-leaved species and curly-leaved pondweed. Pondweeds inhabited approximately 29 acres of the lake, primarily in sparse to moderate densities. Less than 2 acres was inhabited by dense pondweed growth. Approximately 10 acres in the south arm of the lake had no plants or sparse and patchy growths of *Chara*. In general, except for shallow embayments in the south end, this portion of the lake had few plants. The north end of the lake, on the other hand, was almost entirely populated with floating-leaved plants and pondweeds and contained a large dense patch of what was primarily Curly Pondweed.

Past chemical treatments have affected the composition and density of the lake's plant communities which are continuing to evolve in response to those treatments. The first chemical treatment attempt to control plant populations in Lake Killarney occurred in 1979 when an application of endothall was made to control both lily and submerged plant populations. Copper sulfate was also used that first year as a whole-lake treatment to control algae. This plan was repeated the next year, but then records indicate no treatments from 1981 through 1986. From 1987 until 1994 there were six whole-lake treatments with copper sulfate, six treatments with fluridone (Sonar®) usually as partial treatments of about 1/3 of the lake, five partial treatments with glyphosate (Rodeo®), and another treatment with endothall. No treatments occurred during 1994

and 1995, then in 1996 whole-lake treatment with copper sulfate and a partial treatment with fluridone was completed. A more complete history of chemical applications to the lake is included as Appendix A.

Characteristic Use

During development of this plan the steering committee was asked to develop a list of beneficial uses the lake provides and identify where those uses occur. Beneficial uses identified included swimming, boating, fishing, wildlife viewing, and fish and wildlife habitat. It should be noted that boating includes canoe, rowboats, inflatable, and electric motors; no internal combustion engines are al-lowed on the lake. In addition to private dockside swimming, a number of areas were identified as being especially popular for swimming. These included a point located along the western shoreline and the area surrounding three islands located in the southeastern sector of the lake. A conservancy zone was identified by the project Steering Committee that extends along the northern and western shoreline coinciding with property currently owned by Weyerhaeuser, World Vision, and the City of Federal Way. These swimming and conservancy zone areas are shown in Figure 1.

PROBLEM STATEMENT FOR LAKE KILLARNEY

The following list of problems was developed by the Lake Killarney steering committee.

- Aging onsite septic systems may be failing and contributing to water quality problems.
- Native wildlife populations may be declining; ducks seem to be replaced by geese.
- For almost ten years herbicides have been used to control plant and algae problems; this management approach needs to be reassessed in terms of long-term impacts and lake health.
- Purple Loosestrife has invaded the shoreline.
- Lakeside residents need to learn about native versus non-native aquatic plants and long-term protection for the lake and watershed.
- Aquatic plants when left uncontrolled spread throughout the lake and impacted recreational and aesthetic uses and probably impacted fish and wildlife habitat.
- Non-native plants; Eurasian Watermilfoil, White Pond Lily, Yellow Iris, and Purple Loosestrife exist or have existed in the lake and nearshore areas.
- The lake is shallow and therefore contains a large amount of aquatic plant habitat.

The list of problems was used to create a problem statement for Lake Killarney. The purpose of the problem statement is to describe as clearly as possible how the lake and its inhabitants are being negatively impacted by aquatic plants. The following problem statement was developed for the lake:

Over the past 20 years aquatic plant and algae problems have developed in Lake Killarney. These problems included invasion by Eurasian Watermilfoil, White Pond Lily, Yellow Iris, and more recently Purple Loosestrife, in addition to frequent blooms of algae. These plant and algal populations have resulted in decreased recreational use and aesthetic value of the lake to the residents, and may also be affecting the quality of fish and wildlife habitat. Aquatic herbicides have been used to control aquatic macrophyte and algae in Lake Killarney for over ten years. Although this has resulted in adequate control of these populations, residents are concerned over the long-term use of herbicides and their impacts to the lake's ecology and understand that these are methods of treating symptoms rather than a solution to lake problems. There is also a need for education of lakeside residents on issues such as failing septic systems, non-native plant identification and control, and appropriate lawn and garden practices. A plan for controlling aquatic plants needs to be developed that can be relied upon over the long-term to allow the establishment of a healthy, diverse plant community that supports both human and wildlife use of the lake.

AQUATIC PLANT MANAGEMENT GOALS

The final step before beginning development of a plant control plan was to define project goals against which the program could be evaluated. Setting project goals is an important step because they are used to determine what control strategies will work, and will ultimately be used to evaluate whether the program has been a success. The following list of goals for Lake Killarney was developed by the steering committee. A group rating process was used to rank the priority goals for plant control. The ranking process resulted in selection of four priority goals, which are the first four listed below.

Goals List

Priority Goals

- Develop a diverse and healthy balance of native plant communities at a level to support lakeside residents needs as well as fish and wildlife habitat needs, with less dependence upon chemicals. Identify and protect critical fish and wildlife habitat within the lake and watershed.
- Continue to monitor and identify areas of Purple Loosestrife infestation and conduct pulls as needed to eradicate this non-native noxious plant.
- Investigate options for initiating long-term lake level management, especially during low flow (late summer) periods.

- Seek a long-term funding source for implementation of the aquatic plant management plan.

Other Goals

- Promote lake/watershed stewardship and bring about a greater awareness of the continual threat of noxious weeds and homeowner lakeside Best Management Practices (BMPs) through an ongoing public involvement and education program.
- Identify new invasions of Eurasian Watermilfoil or other exotic plants.
- Identify and protect critical fish and wildlife habitat within the lake and watershed.
- Reduce both external (e.g. stormwater and lakeside property) and internal (plants and sediments) sources of phosphorus and other pollutants to the lake.
- Work in cooperation with the City of Federal Way to develop a passive recreational area within the new park that is consistent with lake management goals.
- Develop a working agreement with Washington State Department of Fish and Wildlife to address access and operational hour issues for the public boat launch and incorporate the agreement into plan goals.
- Develop a partnership with the Lake Geneva Association for implementing activities of mutual benefits and utilization of volunteers to minimize costs.
- Establish a relationship with nearby south King County lake residents for sharing of information and communication on the management of their lakes.

RECOMMENDED AQUATIC PLANT CONTROL PLAN

There are four areas of concern associated with the aquatic plant community in Lake Killarney: floating-leaved plants, native submerged plants, non-native submerged plants, and finally control of the emergent plant Purple Loosestrife. All control alternatives described by Ecology (1994) were considered for use in Lake Killarney. Appendix B provides information on the most feasible methods that were presented to the steering committee as possible alternatives. After presenting the wide range of available alternatives for control of each plant community type, three different control scenarios were presented to the Lake Killarney steering committee for consideration in selecting a recommended action plan. The methods for controlling floating-leaved plants, preventing re-invasion by non-native submerged plants, and controlling Purple Loosestrife were the same for all three scenarios. However, there were three separate scenarios presented for controlling submerged plants: mechanical harvesting, stocking with Grass Carp, and continuing to treat the lake with herbicides. Detailed descriptions and comparisons of each of these alternatives as presented to the committee is also provided in Appendix B. The following section contains a detailed description of the strategy that was selected for control of each of the plant community types.

Floating-Leaved Plant Control

The large bed of Watershield and Waterlilies are largely associated with the area that has been designated as conservancy (Figure 2). While the control objective for these stands is to retain the beds, it is also desirable to limit the extent to which they invade nearby areas and to enhance their wildlife and recreational value. (Dense stands of floating-leaved plants have been shown to result in very low oxygen concentrations that may make this habitat unusable for fish and other aquatic life.) To meet these needs targeted applications of an herbicide with the active ingredient of glyphosate (e.g. Rodeo®) is recommended.

Glyphosate was selected for the herbicide treatment because of effectiveness, duration, low cost, and low environmental impact. Glyphosate is a systemic herbicide that is absorbed by foliage and passed throughout the plant. Since it kills the rhizomes, it results in long-term control of the plant community. This herbicide has low toxicity to bottom-dwelling organisms, fish, birds and other mammals and dissipates quickly, therefore it is considered to have a low environmental impact. It is assumed that two applications of the herbicide will be required in any treatment year to insure application success. The herbicide would be re-applied every four years to maintain the control area. To treat a maximum of 1 acre of floating-leaved plants twice per treatment year, is estimated to cost $500 per treatment year. Because the problem plants in this case are not listed in King County's noxious weeds list, an additional cost of $1,300 associated with applying for a sensitive areas code variance is also required. Over the first 10 year period, glyphosate treatment has been estimated to cost $5,400.

Glyphosate would be applied around the edges of the large beds located along the northwest shoreline. To allow a reduced frequency of the application, a 25 foot wide border would be sprayed around the plant bed. As described previously, glyphosate is a systemic herbicide that kills the entire plant. Thus, by periodically treating the edges of the waterlily bed it will effectively limit the extent to which this plant can invade new territory. To enhance wildlife and recreational value of the existing stand it is recommended that a series of 40 foot wide swaths that intersect the beds are opened up. These clearings through the lily bed will enhance fish and wildlife use of the lilies by creating habitat edge and allowing greater circulation and oxygenation of the beds. They will also enhance recreational use of the area by forming pathways for canoes and small boats.

There are also a few small floating-leaved plant beds located in the shallow embayment located along the southwest shoreline and the potential for new invasions along the entire shoreline of the lake. These plant beds provide important wildlife habitat and a necessary diversity of habitat types. The control method for these beds needs to both insure they are largely retained while also allowing lakeside residents with a method of controlling their extent. It is recommended that a hand operated tool such as a lake "weed shaver" be purchased for shared use by the lake residents. Tools such as this can be effective at controlling small stands of lilies, but requires time and energy on the part of the resident. This should indirectly control the amount of habitat that is removed in any one year from the shoreline. The additional cost for purchase of one or two hand operated cutters and seining nets to trap the plants has been estimated at $1,500.

Native Submerged Plant Control

Grass Carp Stocking

After much discussion and detailed review of alternatives, the selected strategy for controlling native submerged plants is stocking with triploid (sterile) Grass Carp. Grass Carp are a plant-consuming fish native to China and Siberia. They are raised commercially in the southeast U.S. for use in lake and pond plant control projects. These fish do not compete with other fish species for either food or spawning habitat and in that sense are a good biological control agent. The fish can reach sizes of 50 to 60 pounds and are said to eat twice their weight in plant matter each day. Thus, they can be very efficient grazers. Normally the fish are shipped from the southeast U.S. and stocked at lengths of 10-14 inches. One of the options that could be considered for Lake Killarney is to stock the lake with larger Grass Carp collected from a lake or pond where they have been overstocked. This would allow for a more reliable stocking estimate and allow more immediate control with fewer fish.

In many ways Lake Killarney lends itself well to stocking with Grass Carp. The fact that the lake has already been treated to control submersed plants means that the carp could be stocked at a low rate based on predicted regrowth of submerged plants. It is also necessary to screen lake inlets and outlets to retain Grass Carp. This can be prohibitively expensive depending upon stream size and hydrology. In Lake Killarney's case, there is no inlet to the lake, thus eliminating inlet screening concerns. And the outlet is through a small culvert that is already screened. Simple upgrading of this structure should be adequate to meet WDFW requirements. The fact that there are no migratory fish that utilize the lake (e.g. salmonids) also reduces screening concerns. One potential drawback to recommending Grass Carp is that current WDFW policy requires a Phase I Lake Restoration study be performed before granting a permit. These studies can be very expensive. Grass Carp have recently been permitted in lakes without the benefit of a Phase I study, setting a possible precedent for allowance. It is also possible that this requirement is being omitted in a new policy being formulated by WDFW. Another consideration is the possibility that WDFW would require some long-term monitoring of the fish, waterfowl, and/or plant populations to allow documentation of the impact of the Grass Carp on other biological communities. Depending upon what is required, this could cost as much as $5,000 on a given monitoring year. An allowance for this additional cost has been included in final plan implementation costs.

If Grass Carp were stocked in Lake Killarney, no other control methods for submerged plants would be necessary. The control method for the floating-leaved plants would still be needed along with a long-term monitoring program.

Assuming a maximum cost of $15 per fish, a stocking rate of 20 fish per vegetated acre, and 20 acres of plants, the cost for stocking would be $6,000. (The number of fish stocked may likely be less than 20 per acre. This number was selected to provide a conservative estimate of cost.) It would cost less than $1,000 to upgrade the outlet screen. (If a Phase I study was required, it would add an additional $100,000 minimum

to the project costs and at least two years to the schedule. It is assumed that if this requirement was not waived, a back-up plan using a control method other than Grass Carp, would be put into effect.) The Grass Carp would need to be replenished every five years which would cost an additional $500. Monitoring costs have been estimated at a maximum of $5,000 every other year, for an average annual monitoring cost of $2,500. It is highly recommended that aquatic plant surveys be conducted annually to track Grass Carp impact and exotic weed introductions.

If Grass Carp are stocked in the lake at a reasonable rate, it should take 3-5 years before any significant change occurs. However, control should continue for another 5-10 years or indefinitely if the carp are replenished every few years.

A critical issue with stocking Grass Carp is knowing how many to stock. A great deal of research has gone into this question, yet answers are still not definitive. That means there is a chance that either too few will be stocked and they will not make sufficient inroads on the plant population, or that too many will be stocked and too many plants will be removed. Removal of too many of the plants is likely to cause large decreases in native fish populations and waterfowl use of the lake. Removing the plants also means that shoreline erosion and sediment disruption can be greater. In other lakes this has resulted in poorer water quality through increased turbidity.

As stated previously, the feasibility of this alternative is dependent upon WDFW policy. Grass Carp stocking permits can be difficult to obtain for natural lakes. However, the extensive history of herbicide use in this lake, in combination with the lack of screening problems may cause WDFW to look more favorably on Carp use in Lake Killarney. Due to the possibility that WDFW would choose to not approve a stocking permit for the lake, a Back-Up plan is required to allow submerged plant control using another method. The selected back-up plan in Lake Killarney is to continue to use herbicides to control the plants. This plan is described below.

The Grass Carp option meets the number one goal set by the committee to reduce chemical dependency in the lake. It also allows for long-term control of the plant problem at the lowest cost of all the alternatives considered. The purchase of handtools as described for control of floating-leaved plants would also provide lakeside residents with a method of controlling submerged plants near their property in the years before the Grass Carp begin to provide adequate control. The cost for hand tools is included under the floating-leaved plan component.

This plan does not exclude the use of additional bottom barriers by lake residents who may want to increase control in the area near their property. However, these activities would not be funded by this plan.

Back-Up Plan / Herbicide Treatment

If Grass Carp are not allowed in Lake Killarney, the back-up plan is to continue to use herbicides to control the submerged plant population. The use of fluridone (Sonar) is recommended at this time and the estimated costs for this alternative are based on use of Sonar pellets. However, if another herbicide becomes approved for use in

Washington State or becomes more accessible for use the it too can be considered for use in the lake.

The current strategy in Lake Killarney has been to treat a portion of the lake (approximately 1/3) with liquid Sonar every year. Although this herbicide is not typically recommended for partial lake treatments, the almost separate nature of the two basins that form the lake, in conjunction with the lack of flushing during the period of application, means that there is minimal dilution of the Sonar. Thus, although this strategy may not represent the most efficient use the herbicide, it has worked on this lake apparently to the satisfaction of lakeside residents. It has the advantage of allowing some plants to always remain in the lake to provide continual habitat and also does not result in as large an addition of nutrients to the lake as would occur with a whole-lake treatment. For these reasons, if a chemical control method is required, it is recommended that the current strategy of treating one-third of the lake on each treatment year be followed. However, to meet the goal of reducing chemical use it is also recommended that treatments be restricted to every other year. Thus, any one area would not be treated more than once every four or five years. The estimated cost for treatment of 1/3 of the lake (using estimated 1997 chemical costs) is $4,700. This cost would be incurred every other year.

Lake residents could also maintain their own swimming/dock areas using hand and boat operated cutting tools described previously. Bottom barrier could also be installed in identified high use swimming areas, however, the costs for this have not been included in this plan.

Exotic Plant Control Plan

The continued herbicide treatments in Lake Killarney appear to have effectively eliminated Eurasian Watermilfoil from the lake for the time being. However, this plant could return to the lake from the introduction of Eurasian Watermilfoil fragments. Other non-native, highly invasive plants of concern include: Parrotfeather (*Myriophyllum aquaticum*), Brazilian Elodea (*Egeria densa*), Hydrilla (*Hydrilla verticillata*), Fanwort (*Cabomba caroliniana*), and Water Hyacinth (*Eichhorinia crassipes*). The focus of control efforts for non-native plants is a prevention and detection program. A contingency plan is also presented in case control of a large area is required.

Invasive Plant Prevention and Detection Program

To be effective this program should include both a source control component (a plan for keeping these plants out of the lake) and a detection program. The objective of source control is to prevent non-native submerged plants from entering the lake. In addition to the threats posed by Eurasian Watermilfoil and Brazilian Elodea, two now common non-native submerged plants that we have been dealing with for a number of years, there is the more serious threat associated with the discovery of *Hydrilla* sp. in area lakes. The public boat launch represents an area where there is a high potential for introduction or re-introduction of invasive plants. The addition of boat and trailer wash facilities is sometimes recommended to enhance plant fragment removal.

Unfortunately, the boat launch area at Lake Killarney is too small to allow addition of these facilities. There are also concerns associated with how the facility would be used and how effective it would be. Consequently, source control will be directed at educating lake residents and the public about the importance of removing plant fragments.

There is currently a Eurasian Watermilfoil control sign at the boat ramp. It is recommended that a larger sign be placed near the entrance to the launch that requests boaters to stop well away from the water and check their boat and trailer for plant fragments before launching. Lake residents should also receive informative brochures on an annual basis reminding them of plant invasion problems and the importance of keeping their own equipment free of plants. It is also recommended that the lake community institute some public information campaign for opening day of the fishing season and a few other key weekends. Simply having volunteers hand out brochures for a few hours and help with boat and trailer checks will emphasize the importance of the effort and remind boaters of their responsibility to check equipment.

Early detection is the next step to protect against new infestations. While an infestation is still relatively small there are options for control that are much less expensive than whole-lake treatment. Early detection, if done properly, requires both a trained group of lake volunteers who are responsible for periodic patrol of the lake, and periodic diver surveys to assess the plant community. The main purpose of these surveys is to search for Eurasian Watermilfoil and any other exotic plants and handpull and remove them. However, it will also provide a means for monitoring the native submerged plant community and determining where future control efforts should be focused. Volunteers would be trained each year in plant identification and survey techniques and each would be given the responsibility for surveying a certain section of shoreline once a month during the growing season. Their purpose would be to note any substantial changes in the plant community and to look for new invasions of nuisance species. (The citizens of Lake Killarney have already implemented their own volunteer plant surveys. Appendix C contains a copy of a manual produced by lake residents that describes volunteer surveys.) Professional divers would perform a more complete survey every other year. While the divers are surveying the lake they can determine whether new infestations can be handled by handpulling the plants or whether, for example, bottom barriers should be installed in a few places to ensure complete control.)

The primary advantage of controlling small infestations is that it reduces the chance that a large area would need to be controlled by a more intensive technique. A drawback of controlling small infestations is the high cost associated with diver surveys and hand pulling. A survey of the entire plant habitat would take approximately 1 day and cost approximately $1,500. This should be scheduled to occur at least every other year. (Costs for hand pulling by contract divers range from $500 to $2,400 per day depending upon plant type, acreage, and density.)

The exotic plant control plan should include a contingency fund for use in controlling large areas of new infestations of Eurasian Watermilfoil or infestations by one of the even more invasive aquatic plants. A contingency fund of $10,000 is recommended to insure funding is immediately available in the case of a new invasion.

The exotic plant control plan complements the plan for control of native submerged plants. The bi-annual survey would be relied upon to detect new infestations of Eurasian Watermilfoil and allow immediate removal of the plants. If Eurasian Watermilfoil or another exotic is found, a second dive would be planned for later in the same year to insure there were no surviving colonies. If the area infested is too large to control by handpulling, or if after two follow-up dives the exotic is still found, bottom barriers would be placed in all areas where the plant was detected. Treatment with herbicide is recommended as a final resort if these efforts do not result in eradication of the exotic plant.

These additional diver surveys, bottom barrier installation, and herbicide treatments are contingency elements to the overall aquatic plant control plan for the lake. Since these cost would only accrue in the event of another infestation by Eurasian Watermilfoil or another exotic plant, the costs may be covered through an "early infestation grant" by the Department of Ecology. Therefore these costs have not been included in the total estimated costs for this project.

Emergent Plant Control / Purple Loosestrife

The plan for control and ultimate eradication of Purple Loosestrife is to continue with the annual volunteer handpulling events until the plant is removed from the shoreline. However, lake residents should be aware that control of this plant can quickly get out of hand. If at any time the population appears to be increasing or if handpulling does not appear to be reducing the population, residents should consider reverting to a herbicide spraying program for one or two years. It has been estimated to cost approximately $1,500 per treatment year to have an applicator spot treat the lake edge with glyphosate to kill these plants.

Plant Control Advisory Committee

Proper implementation of the described plan relies upon formation of a lake plant control advisory committee. This committee would have the following responsibilities:

- Review annual plant survey information (collected by volunteers and professionals) and track potential problem areas.
- Organize Purple Loosestrife pulling events, or make decisions on the use of a chemical control method.
- Insure permit requirements are met.
- Review herbicide application needs for floating-leaved plant control.
- Review submerged exotic plant problems and determine the appropriate control strategy and urgency of control needed.
- Recruit and direct volunteers for annual surveys.

- Select and hire contractors when necessary for tasks such as providing training, spraying, diving, etc.
- Provide information and newsletters to lake residents and perform as spokespeople for answering questions on plant control problems and supporting long-term implementation of this plan.
- Conduct annual evaluation to determine if implementation activities are meeting plan goals and make recommendations for the next year.

PUBLIC EDUCATION PROGRAM

The public education program for Lake Killarney consists of three parts: 1) the exotic plant prevention plan; 2) educational activities to alert homeowners about lawn, garden, and home keeping best management practices for protecting the lake's water quality; and 3) annual workshops on the use of the handcutting tools, plant survey results, and other lake issues.

1) All watershed residents should be sent copies of a Eurasian Watermilfoil prevention brochure. A group of lake homeowners should be trained to identify Eurasian Watermilfoil and other invasive plants and perform periodic volunteer surveys of the lakeshore.

2) To protect the lake from future water quality degradation, lakeside residents should also be provided with a series of informational brochures describing how lawn, garden, and housekeeping practices can impact lake water quality. Brochures could cover proper landscaping techniques to deter waterfowl and prevent pollution, maintaining a pollutant free zone within 50 feet of the shoreline, providing shoreline fish habitat, proper septic system maintenance, and other appropriate subject matter.

3) Public education and involvement will also center around the annual plant survey. In the spring of each year the plant control advisory committee should plan a short workshop to describe plant survey results from the past year and their plant control strategy for that year. During the workshop, volunteers should be trained on use of the handcutting tools, and a schedule agreed upon for volunteer surveys. At this time everyone should be trained or re-trained on plant identification and survey techniques.

The King County Water and Land Resource Division's Lake Stewardship Program is a resource for technical assistance and noxious weed identification training. They are currently applying for a grant to develop a county-wide aquatic noxious weed volunteer monitoring program. The Lake Killarney community would be a likely participant. The program also offers speakers on lake-related topics and can tailor programs to the community needs.

Since much lake-related public education information is already contained in available brochures, there is little cost associated with developing the information. A $2,000 cost has been included for development and reproduction of brochures, with an additional

$250 for mailing and postage. It is assumed that the first plant workshop would be done by a professional who can develop a training and survey program. After that the workshops would be put on by lake resident volunteers. The cost for the initial workshop is estimated at $1,500.

Watershed protection/pollution prevention

Lake residents need to monitor watershed related activities to insure that appropriate best management practices (BMP's) are being carried out in nearby commercial and residential developments. This should include: tracking where activities are occurring, reviewing permit applications to insure proper BMP's have been included, reporting violations to permit conditions or water quality standards, and generally keeping informed about the watershed problems.

Lakeside Stewardship Education

In addition to monitoring watershed activities, each lakeside resident should be educated about how to reduce the amount of pollutants entering the lake from their property, as well as about things they should do to help retain a complex, diverse, and therefore healthier lake environment. Properties located directly adjacent to the lake have the greatest potential for adversely impacting the lake since pollutants generated on these properties have direct access to the water. This is especially true for Lake Killarney since no other defined surface inflows exist.

Lakeside property owners should be provided with information about problems associated with typical urban type landscapes around lake shorelines. This should include information on the drawbacks of using ornamental turf (lawns), and the benefits of adding shoreline plants and diversified lawn plantings which create habitat structure for birds and wildlife.

Some important considerations for proper stewardship of lakeside property are described here. An informative brochure or newsletter articles should be used to educate lakeside property owners about these BMP's:

- If turf and landscaped areas are desired, this area should be limited to no closer than 25 feet to the shoreline. Native plants and grasses should be considered for landscaped areas to decrease the amount of fertilizers, pesticides, and other pollutants used.
- Establish a "pollutant free zone" within 50 feet of the shoreline. Try to keep all pollutants—gas for boats, painting projects, landscape fertilizers and poisons, etc.—away from this zone.
- Plant a shoreline buffer of shrubs and tall grasses, preferably native species. This one small activity will cause multiple environmental benefits. If properly designed it will keep geese and other waterfowl from moving onto lawn areas. The vegetation will help filter out pollutants from landscaped areas before they reach the lake. It

will provide protection from shoreline erosion, and it will provide habitat for the many wildlife species that utilize nearshore areas.

- Do not remove natural "structure" that exists along the shoreline, or if necessary clean up only a narrow strip alongside the dock area. If a tree along the shoreline finally falls in, leave it. Add structure in the form of trees or tree tops, bundle branches and twigs together, or add large rocks to diversify and naturalize your waterfront area and attract more fish and wildlife.
- Allow emergent vegetation, and other plants to colonize some portion of the waterfront area.

PLAN ELEMENTS, COSTS, AND FUNDING

Table 3 provides a summary of each element identified in this plan and the associated costs. Total cost for the plan for the first ten year period is estimated at $60,100, for an average of about $6,010 per year. The majority of the cost occurs during the first year when all of the plan components are implemented simultaneously, some of these (e.g. volunteer training, purchase of handtools, and public education brochures) could be offset to the following year to spread out the costs.

To implement this plan a stable long-term funding source would be a great advantage. Currently, plant control activities are funded through an informal volunteer arrangement. A request (usually for $100) is sent to all lake residents each year and those wishing to participate contribute to the fund. The large corporations that exist on the lake, are also asked to contribute to the plant management fund. Typically they are requested to contribute $500 each year. To date, this informal arrangement has worked for the community. The one drawback to the arrangement is that annual decisions about plant control activities are based on the amount of money available rather than on the amount needed to reach some defined goal.

Formation of a special taxing district called a "Lake Management District" or LMD has become the most common way of obtaining funding for lake projects. LMDs are similar to Local Improvement Districts (LID) which are formed when a capital project is planned that primarily or wholly benefits only a subset of the citizenry. Each property owner is assessed a "tax" based on some equitable plan for valuation. Perhaps the most simple valuation plan is a per household basis. Rate structures can also be fairly complex, taking into account some combination of lakefront footage, property acreage, the extent of improvements, proximity to the lake, and the extent to which the improvement will benefit the property. The development of the rate structure can be critical to approval of an LMD, since balloting according to state enabling legislation is weighted to provide one vote for each dollar of tax paid to the LMD.

An LMD would both insure an appropriate level of funds were available and also insure that the amount contributed by each property owner be based on some equitable determination. However, at this time the steering committee members do not feel there is adequate need for setting up a more formal funding mechanism and that there would

probably not be support for this by the community. Therefore, a long-term funding plan has not been recommended.

The Department of Ecology Aquatic Weeds Management Program can be applied to for additional funds to implement this plan once it has been approved by the department. However, this grant program has become highly competitive, and priority is given to lakes with exotic plant problems, which no longer applies to Lake Killarney. This program should not be relied upon for additional grant moneys. Furthermore, this program is not appropriate for use as a long-term funding source because there would be no guarantee from year-to-year that funding would be received. (It should be noted that in the case of re-invasion by an exotic plant, implementation of the exotic plant control portion of this plan could be funded through an early-infestation grant from the Department of Ecology Aquatic Weeds Management Program.)

IMPLEMENTATION AND EVALUATION

The following is a detailed step-by-step approach to implementation of this plan:

Step 1) Set up a Plan Implementation Committee

The first step to implementing the plan is to set up an organization or committee that will take responsibility for it. The lake community, not the County, will control how and whether the plan is implemented. Many of the tasks this committee will need to carry out are described in the plan under the "plant control advisory committee" section.

Step 2) Secure a funding source

Although it may not be necessary to implement all of the plan elements within the first year, they should be implemented at least over the first two years which will require about $20,000, and it will require an estimated average of $6,000 each year to fully implement. The source for this money should be identified and a budget created.

Step 3) Apply for Grass Carp Permit

A permit application from WDFW should be requested, completed, and sent in along with a copy of the Lake Killarney Integrated Aquatic Plant Plan. A meeting should be scheduled with department personnel to discuss the application and describe the reason behind selecting Grass Carp as an alternative. Committee members should be prepared to work closely with WDFW to promote this project, and discuss stocking and monitoring needs. (If Grass Carp are approved, a screen may need to be designed for the outflow and a program for additional monitoring may need to be agreed upon.)

Step 4) Institute long-term plant monitoring program

Develop a list of lake volunteers interested in conducting annual aquatic plant surveys. Develop a plan for training volunteers, doing the surveys, and handling and reviewing

the information. Contact professional aquatic plant experts for conducting bi-annual surveys.

Step 5) Select and purchase handtools

Committee members should collect brochures on available hand control tools and order those they select. A system for allowing residents to have access to the tools (where they will be located, how they will be signed out, etc.) should be set up and lake residents notified.

Step 6) Prepare a plan for educating lake residents about lake protection issues

Meet with King County lake stewardship program staff and collect available brochures. Encourage or elect a lake volunteer to participate in the new King County Master Lake Stewardship program. Solicit professionals to volunteer to make presentations to the community and set up dates for presentations. Also develop an article for each newsletter describing different lake protection issues.

Step 7) Organize future Purple Loosestrife pulls

Set a date and advertise for volunteers as in past efforts.

Step 8) Conduct annual evaluation

Complete a written annual evaluation that describes what elements of the plan have been implemented, relates the existing plant community to established goals, and makes recommendations for the next years activities.

As implied in Step 8, it is important that there is some mechanism in place for periodic evaluation of this plan and determination of whether it is meeting stated goals or whether the goals have changed. This evaluation should be done on a yearly basis. It should begin with a description of which elements of the plan have been fully implemented, which have not, and why. It should also include a summary of the aquatic plant monitoring results, both those obtained by volunteers and those by professionals. These results should be used to aid in the determination of whether goals have been met. The community should also be asked for input on their satisfaction with plant conditions. (It is possible that the goals will be met, but that some people will still be dissatisfied. Although it is unlikely that everyone's needs will be met, an effort should be made to track concerns, especially if they are widespread.) This information should be used to decide on the following years activities: Should more handtools be purchased? Does a herbicide treatment of the lilies need to be scheduled? Is Purple Loosestrife being controlled? Is it necessary to implement the back-up or contingency plan? Over the long term, adequate annual evaluations can make the difference between project success or failure.

Table 3. Estimated cost for implementation of the Lake Killarney Aquatic Plant Control plan. Costs shown in italics represent contingency planning elements and have not been included in the Total cost estimates.

Plan Element	Year 1	Year 2	Year 3	Year 4	Year 5	Total 10 year	Total 20 year
Floating-leaf Plants							
Herbicide/Rodeo		$1800			$1800	$5,400	$12,600
Handtools	$1,000				$500	$1,500	$3,000
Submerged Plants							
Grass Carp	$6,000				$600	$7,200	$8,400
Screening	$500					$1,000	$1,500
Monitoring[1]	$5,000		$5,000		$5,000	$25,000	$30,000
Back Up Plan[4]	*$0*		*$4,700*		*$4,700*	*$18,800*	*$40,300*
Exotic Plant Control							
Volunteer Surveys[2]	$1,500	$0	$0	$0	$0	$1,500	$1,500
Diver Surveys	$2,000	$0	$2,000	$0	$2,000	$10,000	$20,000
Contingency Plan[3]					*$10,000*		*$20,000*
Loosestrife Hand Pull	$0	$0			$0		
Herbicide [3]	*$0*	*$0*	*$1,500*	*$1,500*	*$0*	*$3,000*	*$3,000*
Public Involvement							
Mailings/Postage	$250	$250	$250	$250	$250	$2,500	$5,000
Advisory Comm.	$0	$0	$0	$0	$0	$0	$0
Brochures	$2,000				$2,000	$6,000	$12,000
Total Cost	$18,250	$2,050	$7,250	$250	$12,150	$60,100	$94,000

(1) This includes fishery, waterfowl survey, and possible additional aquatic plant (diver) survey costs. The ultimate cost will be dependent upon WDFW requirements. This is the estimated maximum cost.

(2) This includes cost for one years training and survey set up and assumes lake residents will coordinate future efforts.

(3) These elements form the contingency plan for plant control. These costs have not been included in the total cost summary. It is unknown at what frequency they would be required, if required at all.

(4) Sonar costs are based on predicted 1997 chemical costs.

SUMMARY AND CONCLUSIONS

The continued use of Sonar over the past 10 years appears to have resulted in the complete removal and possibly eradication of Eurasian Watermilfoil from Lake Killarney and resulted in large reductions in native submerged plant populations. However, the shallow nature of the lake has resulted in return of the plants to what is considered a nuisance condition by the community within a few years. The large bed of floating-leaved plants located in the northern end of the lake and a few smaller beds located elsewhere also can restrict lake use. This report details a plan for limiting the submerged plant population through stocking of vegetation-consuming Grass Carp and maintaining the extent of the floating-leaved plant community through occasional use of the herbicide Rodeo. Control of the plant community also relies on the use of handcutting tools to keep the population in check, and yearly monitoring to evaluate conditions. Re-invasion by Eurasian Watermilfoil or other non-native plants will be closely monitored through annual diver surveys, and a contingency plan is included in case invasions do occur. Public education and awareness programs will be focused on Eurasian Watermilfoil prevention, and providing general pollution prevention and best management practices information to lake residents. Furthermore, lake residents will be involved in development of the yearly plant control strategy and will be responsible for soliciting volunteers for surveys and emergent plant control activities. This will insure long-term involvement of lake residents in lake management decisions and activities. Implementation of this plan is estimated to cost a maximum of $60,100 over ten years, or a maximum average of $6,010 per year. (This cost could be as low as $2,270 per year depending upon monitoring requirements associated with the Grass Carp permit.)

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APPENDIX A

History of Herbicide Applications to Lake Killarney

History of Herbicide Applications to Lake Killarney

The first chemical treatment attempt to control weed populations in Lake Killarney occurred in 1979. The chemicals Kuron® and Aquathol-K®, in the form Aqua-Kleen, were applied on lilies and submerged plants. Copper Sulfate was also used as a whole-lake treatment for algae control that first year. This plan was repeated the next year, but then records indicate no treatments from 1981 through 1986. From 1987 until 1996 (excluding 1994 and 1995), applications included Copper Sulfate for whole-lake treatment of algae control, Rodeo® for lilies and submerged plants (mostly spot treatments), spot treatments of Sonar®, and a one-time application of Aquathol® and Diquat® in 1990 to control pondweeds. In 1990 and for a few years after, it was noted that large mats of bottom sediments were rising to the surface of the lake, as a result of decaying lily roots.

Chronological Order of Treatments

Year	Plants Controlled/Area Covered	Herbicide	Active Ingredient
1979	Lilies and submerged plants/unknown	Aqua-Kleen (Kuron® & Aquathol-K®)	2,4-D, Endothall
1979	Algae control/Whole-lake treatment	Copper Sulfate	Copper Sulfate
1980	Lilies and submerged plants/unknown	Aqua-Kleen (Kuron® & Aquathol-K®)	2,4-D, Endothall
1980	Algae control/Whole-lake treatment	Copper Sulfate	Copper Sulfate
1987	Submerged plants/Whole-lake treatment	Sonar® & Rodeo®	Fluridone & Glyphosate
1988	Lilies/Spot treatments	Rodeo®	Glyphosate
1988	Submerged plants/Spot treatments	Sonar®	Fluridone
1989	Lilies/Spot treatments	Rodeo®	Glyphosate
1990	Lilies/Spot treatments	Rodeo®	Glyphosate
1990	Algae control/Whole-lake treatment	Copper Sulfate	Copper Sulfate
1990	Pondweeds/spot treatment	Aquathol® & Reward®	Endothall, Diquat di-bromide
1991	Submerged plants/10 acres	Sonar®	Fluridone
1991	Lilies/Spot treatments	Rodeo®	Glyphosate
1991	Algae control/Whole-lake treatment	Copper Sulfate	Copper Sulfate
1992	Submerged plants/Spot treatments	Sonar®	Fluridone

1992	Algae control/Whole-lake treatment	Copper Sulfate	Copper Sulfate
1993	Submerged plants/Spot treatments, two in north end and three in south end of lake	Sonar®	Fluridone
1993	Algae control/Whole-lake treatment	Copper Sulfate	Copper Sulfate
1996	Submerged plants/Spot treatment (approx. 7 acres)	Sonar®	Fluridone
1996	Algae control/Whole-lake treatment	Copper Sulfate	Copper Sulfate

APPENDIX B

Aquatic Plant Control Methods Considered For Lake Killarney

Floating-leaved Plant Control

By character, floating-leaved plants are found in nearshore areas and are most problematic in areas of four feet depth or less. Currently, there are approximately 3.5 acres of floating-leaved plants in Lake Killarney. The majority is located along the northwest shoreline in front of undeveloped property. Small floating-leaved plant beds located within the shallow bay along the southwest shoreline may also begin to create access difficulties if they are not maintained within current boundaries.

To meet WDFW requirements, the floating-leaved plant control plan must leave a minimum of 25% of the lily habitat for fish and wildlife habitat. The steering committee agreed this could best be accomplished by leaving the majority of the existing large bed located along the northwest shore as a conservancy area. As described in the report, the primary management goal for this area is to retain the plant beds while not allowing them to colonize new habitat. Secondary goals include increasing the habitat value for fish and wildlife and enhancing recreational opportunities for navigating within the bed. For the purposes of the following comparisons it is assumed that a maximum of 1 acre of this bed should be treated or removed.

In order to allow evaluation based on different control intensities and control zones, floating-leaved plants control alternatives are separated into two categories; methods that are more appropriate for control of small areas, and those that are appropriate for control of large areas of floating-leaved plants.

Floating-leaved Plant Control Methods for Small Areas

Hand Cutting

Hand cutting is a manual method of cutting stems of aquatic plants close to the sediment surface. Two tools that are most effective on waterlilies include the Water Weed Cutter and the Lake Weed Shaver (McComas 1993). The Water Weed Cutter has a V-shaped, straight-edge blade that cuts a 3-foot path. It is best used by throwing it from the shore or dock and pulling it back with a jerky motion. The Lake Weed Shaver has a straight-edge blade that cuts a 6-foot path. Because of its weight, it is best used by dragging it behind a boat. To be most effective, either tool should be used before the waterlilies become very dense and the blade must be routinely sharpened.

Although cut fragments of floating-leaved plants will not re-root and grow as in the case of some submerged plants, these fragments should still be removed to prevent aesthetic impacts from floating debris and onshore decay of the plant material. Cut fragments float and are best removed with a modified fish seine that encircles small working areas or is positioned down-wind of the working area. The net should have at least a 1-inch mesh so that it will not trap small fish.

There are no depth limitations for these tools and therefore the control zone for this method could include any portion of the lake's floating-leaved plant beds. However, since it requires manual labor it is best suited for small patches of lilies that may be hindering lake

access. Because plant roots (rhizomes) are not removed using these tools, the duration of control is comparatively low. The frequency of application is dependent on water depth; monthly cuts will maintain deep areas, but more frequent cuts may be necessary for areas less than 3 feet deep.

Equipment costs are low: $100 for the Water Weed Cutter, $200 for the Lake Weed Shaver, and $500 for a modified fish seine. The estimated 10-year cost is $2,600 which includes purchase of two nets and one of each cutting tool and replacement of the tools after five years. This cost does not include labor provided by property owners. The primary advantage of hand cutting is the low cost and the ability to be very selective about the area controlled. The primary drawback is the high amount of labor required to provide adequate control. It has been estimated to require about one hour to cut a 50'x100' area when using a boat to assist the effort.

Weed Rolling

The Weedroller is a relatively new product that controls aquatic plant growth by periodically disturbing the lake bottom. The drive head is typically mounted to the end of a dock in water depths of up to 8 feet. It slowly rotates a string of three aluminum tubes which repeatedly roll over a broad arc on the lake bottom. Each 6-inch by 10-foot tube is connected with a flexible coupler to follow the bottom contour. The Weedroller is operated by 110-volt household current which it converts to 24-volt direct current (DC) and covers up to a 270° sweep in 15 minutes. Adequate control is typically achieved by operating the Weed Roller continuously overnight once every week or two during the growing season.

Since a power source and structural support is required to operate the weed roller, the control zone is limited to area directly adjacent to docks. King County Surface Water Management Division tested the use of these weedrollers at three lake sites during 1995. The Weedroller was found to effectively decrease floating-leaved plants and milfoil stands from 50-90% coverage to less than 25% coverage with fewer than 12 hours of operation a month. Some temporary indirect effects were noted for increased water turbidity and possibly effects on bottom dwelling organisms.

A complete unit with accessories sells for approximately $2,500. This cost does not include installation and electricity. This tool would not be considered for use on the large lily bed due to lack of a power source, installation , and ineffectiveness for controlling large areas. Advantages of the Weed Roller include the high degree of control, low amount of labor, and the fact that it will control all plant types within its path. The main drawback is the limited area of control. Also, the plant fragments that are formed can cause problems for nearby residents if not removed. The Weed Roller requires hydraulic approval from the Washington Department of Fish and Wildlife.

Bottom Barriers

Bottom barriers are manufactured sheets of material that are anchored to the lake bottom to prevent plants from growing. These are similar to weed barriers commonly used in lawn and garden activities. Several bottom covering materials have been used with varying degrees of success. A woven polyester material such as Texel® is one of the most effective bottom barriers because it is durable and it provides efficient exchange of gas

produced from decaying organic matter (roots). It is typically installed in the winter, when lilies are not present, by unrolling 30×50-foot sections and anchoring them with sand bags spaced 10 feet apart. Bottom barriers should be maintained on an annual basis to ensure adequate coverage and anchoring. Bottom barriers can be relocated to other areas after 2 years if sediment accumulation is not excessive. Re-installation may be necessary to control encroachment of lilies in areas adjacent to dense growth.

There are no limits to the control zone for bottom barriers. They are effective in deep as well as shallow water and do not have special requirements that eliminate their use in different areas. The control zone would be defined by the number of 30 x 50 foot sections installed. Further, they can be used to control submerged plants as well as lilies. Control intensity and duration varies depending upon sediment accumulation and encroachment from adjacent area. If properly installed and maintained annually, bottom barriers can provide a high level of control for five years or more.

The cost of applying bottom barriers is approximately $0.80 per square foot ($35,000 per acre). Annual maintenance costs are estimated to be $5,000 per acre. The estimated 10-year cost is $80,000 based on 1 acre of material, which could be relocated to control up to 4 acres of lilies. The primary advantage of bottom barriers is the intense level of control and the ability to be very selective about the control area. The main disadvantage is the high cost per acre controlled. Bottom barriers require hydraulic approval from the Washington Department of Fish and Wildlife and a shoreline permit from King County.

Large Area Floating-leaved Plant Control Methods

Mechanical Harvesting

Mechanical harvesting involves cutting plants below the water surface, conveying them onto the harvester, and offloading them at the boat launch for disposal or composting at a suitable site. Harvesters are manufactured by several companies; various sizes and features are available to meet specific requirements. Maximum cutting depths range from 5 to 8.2 feet with a cutting width or swath of 6.5 to 12.1 feet.

Harvesting provides immediate control of the problem plants, but the duration of control depends on water depth and the depth of cut. Past experience with harvesting waterlilies indicates that adequate control could be achieved with two or three cuts per season.

Harvesting of floating-leaved plants in Lake Killarney could be performed at a cost of approximately $1,500 per acre per year, based on two cuts each year. The estimated 10-year cost is $15,000 based on a control area of 1 acre. The primary advantages of harvesting are the immediacy of the control and the fact that plant material that would normally add to the lakes nutrient load and cause increased sedimentation is removed from the lake. The primary drawback of harvesting is the shorter duration of control and therefore the need for repeated treatments. Mechanical harvesting requires hydraulic approval from Washington Department of Fish and Wildlife.

Dredging

Dredging, or removing accumulated sediments has typically been used to either deepen a lake, or to remove nutrient laden sediments for water quality improvement. It can also be used to control the amount and type of aquatic plant habitat present. This is based on the idea that different plant types grow best at different water depths, therefore, if sediments are removed (causing deeper water) plant types will change accordingly. If enough material is dredged to reach background soils that do not support aquatic plant growth, then dredging actually results in elimination of plant habitat.

A portable cutter-head dredge could be used to remove sediment and plant tubers from the lake. A slurry of chopped sediment material and lake water is pumped to shore for dewatering and disposal. Dredging would result in short-term, localized water quality impacts, but may also result in long term improvement in lake water quality due to removal of nutrient laden sediments.

The design of the dredging program could vary widely from increasing the depth of the entire lake by 4 feet or more, to dredging a narrow band near the lily bed to decrease available lily habitat. Costs would change accordingly, since cost is based on the volume of material removed. Costs for dredging can be expected to vary widely depending upon project objectives and disposal options. A minimum cost would be close to $500,000, while a large-scale project could be three to four times that estimate.

Advantages of dredging are the high intensity and long duration of control, and the benefit of increased water depth. For a small dredge project (small area and minimum depth gain) the duration of control may exceed 10 years for isolated lily patches, but may not exceed 5 years in areas adjacent to lilies left for conservancy. A small-scale dredging operation in shallow areas of the lake is unlikely to significantly improve water quality by removing nutrient-rich sediment, nor is it likely to significantly reduce suitable habitat for growth of submergent vegetation. A full-scale dredge project could result in large-scale reductions in available plant habitat, improved water quality, and a control duration of 10-50 years. The primary drawback of dredging is the high cost.

Dredging requires hydraulic approval from the Washington Department of Fish and Wildlife, a temporary modification of water quality standards from the Washington Department of Ecology, a section 404 permit from the Army Corps of Engineers, and Shoreline permit from King County.

Herbicides

Glyphosate is typically the herbicide recommended for floating-leaved plants control, because of its low toxicity, fairly low cost, and because it kills the entire plant rather than just causing it to die-back. Glyphosate is a systemic herbicide that is applied to the leaves of actively growing waterlilies. Glyphosate is formulated as Rodeo® or Pondmaster®. The herbicide is rapidly absorbed by the leaves and translocated throughout the entire plant including the roots (tubers). Wilting and yellowing of plants occurs within 7 days, followed by browning and death. Complete control may require a second treatment in the following year. Submerged plants are typically not affected by a glyphosate treatment.

Duration of control varies with depth and distance to nearest lily bed. Encroachment from adjacent stands of lilies will begin immediately and will be most efficient in nearshore areas. Experience on Steel Lake in the City of Federal Way indicates control from glyphosate should last for a period of three to four years.

The primary advantage of glyphosate treatments are the low cost coupled with relatively long-term control of the plants. It is considered to have a very low toxicity to aquatic animals and comes with no swimming or fishing use restrictions. However, it is a chemical control method and therefore there are implied concerns associated with the use of toxins in natural environments. Other than chemical use concerns, the primary drawback of glyphosate use is the water quality impact from the release of nutrients by decaying vegetation. There is also concern associated with the possibility of affecting emergent vegetation from drift of the applied herbicide. Herbicides can cause "rafts" of dead roots to form and float around the lake. An Hydraulic Project Approval is needed to remove these rafts.

Treatment costs by private contractor average $500 per acre per year fro two applications. Plus, there is an additional $1,300 permit cost each year. The estimated 10-year cost is $5,400 based on three treatments of 1 acre. Herbicide treatments require a temporary modification of water quality standards from the Washington Department of Ecology.

Native Submerged Plant Control

The number two goal identified by the steering committee was to control submerged plants to a level that does not hinder recreation. Historical observations indicate that the native pondweeds *Potamogeton amplifolius* and *P. pusillusi* can reach nuisance proportions. It has been estimated that the maximum extent of such species would be approximately 10 acres. Other native submerged plants such as *Nitella,* and *Najas flexilis* do not grow tall enough or are not dense enough to hinder recreation in Lake Killarney. These are important plants to protect since they provide valuable wildlife habitat and their presence eliminates plant habitat that might otherwise be available for invasion by one of the more nuisance plant types. *Nitella* also takes its nutrients from the water and competes directly with algae, so its presence can deter algae growth. Therefore, alternatives considered for native submerged plant control focused on controlling pondweeds while not adversely affecting the existing populations of other native plants. An additional requirement is that the method selected should not promote the growth of milfoil or other non-native submerged plants.

Currently, pondweeds are not present in densities that hinder recreation. During both 1993 and 1994 (before the sonar treatment) submerged plant densities were particularly low. The sonar treatment has caused an even further decline in the population. Therefore, alternatives are considered separately for the small pondweed population that currently exists, and for a large pondweed population that could be present in the future.

Selective Submerged Plant Control Methods

Hand Pulling

Hand pulling is a manual method of removing the entire plant, including roots. It is typically performed by divers uprooting individual plants, placing them in a mesh bag, and disposing or composting the removed material. Handpulling is not limited by depth or access problems, and in theory all problem areas could be controlled in this manner. However, the labor intensive nature of the work would limit control by this method to a maximum of 2 acres a year. Adequate control would be achieved by hand pulling plants once during early summer of each year in designated areas. Continual use of this method should help limit expansion of plant beds and maintain lower overall densities of the problem plants. The plant density and the level of effort should decrease in subsequent years.

Costs for hand pulling by contract divers range from $500 to $2,400 per day. Low to moderate pondweed densities could be controlled at a rate of approximately 0.5 acres per day. The estimated 10-year cost is $80,000 based on $2,000 per day and an average control area of 2 acres. The primary advantage of hand pulling is that non-target (beneficial) plants are not removed and may even colonize area inhabited by nuisance plants, due to the large competitive advantage they would be given. The primary drawback is the high cost per unit area controlled due to the high labor cost. An Hydraulic Project Approval permit (HPA) from WDFW is required for large scale handpulling efforts.

Hand Cutting

Hand cutting tools available for controlling waterlilies would also work for submerged plants. In addition, weed cutters with reciprocating blades could be used for pondweed control. For example, the Water-Weeder is a battery-powered, hand-held cutter that cuts a 4-foot swath down to 12-feet deep, and can be purchased for approximately $500. Hand cutting of pondweeds is less labor intensive than floating-leaved plants control because of lower pondweed biomass.

Handcutting tools should allow adequate control within the problem areas identified in Lake Killarney. The control zone would primarily be limited by the amount of labor available. Acreage located near private property could be controlled by individual property owners. Approximately two cuts per year should be adequate to maintain the pondweed to an acceptable level. The estimated 10-year cost is $2,000 which does not include labor provided by property owners.

Weedrolling

Weedrollers could be used for submerged plant control as described for waterlilies. Unit costs are the same for both types of plants. The area that can be controlled by this method is limited to the area immediately adjacent to the power source (shoreline or dock). The estimated first years cost is $100,000, which is based on 40 units to control only 0.5 acres, and does not include installation and electricity. Since this is new technology the average useful life of a weed roller is unknown. Assuming a maintenance cost of $500 per year, and a lifespan of over 10 years on each product, the estimated 10-year cost would be $105,000.

Bottom Barriers

Bottom barriers could be used for submerged plant control as described for waterlilies. Installation costs are the same for both types of plants, but annual maintenance costs would be about 25 percent less for submerged plants because encroachment over the top is not as rapid. The estimated 10-year cost is $65,000 based on 1 acre of material, which could be relocated to control up to 4 acres of pondweeds.

Extensive Submerged Plant Control Methods

Mechanical Harvesting

Mechanical harvesters could be used for submerged plant control as described for waterlilies. Unit costs would be approximately 50 percent lower for submerged plants because of lower biomass and a smaller control area. The estimated 10-year cost is $75,000 based on two cuts per year and a control area of 10 acres.

Dredging

Dredging of submerged plants could be performed as described for waterlilies, with similar unit costs. Alternatively, submerged plants could be controlled with diver-operated suction dredging of shallow sediments and roots (e.g., dredge depth of only 6 inches versus 2 feet for floating-leaved plants control). Suction dredging typically filters plant material and returns removed sediment and water to the lake. Material returned to the lake would temporarily decrease water clarity, but should not have long-term effects on water clarity. Costs of suction dredging are lower than cutter-head dredging because disposal costs are reduced. The primary advantages of diver-dredging is that is can be site and species specific, there are no obstacle or depth constraints and there are no associated disposal costs since all material is returned directly to the lake. Disadvantages are that it is slow and labor intensive and therefore expensive. Also, the process can result in production of plant fragments that can re-root and cause problems in other places.

Unit costs of suction dredging range from $1,100 to more than $2,000 per day. Assuming a daily rate of 0.5 acres at $2,000 per day, the 10-year cost of controlling 10 acres is $40,000. However, costs would double if regrowth requires additional control in the 10-year period.

Herbicides

Of the herbicides currently approved for use in Washington State, fluridone is the preferred herbicide for submerged plant control. Fluridone is a slow-acting, systemic herbicide that is applied to the water surface either as a liquid or slow-release pellets. Fluridone is formulated as Sonar® for aquatic application.

The herbicide is effectively absorbed and translocated by both roots and shoots. Its use is most applicable to lake-wide treatments. Therefore, the control zone typically includes the

entire open water area of the lake. Because it kills the plant and roots it has a relatively long control duration; four to five years. Fluridone is also effective at eliminating the non-native Eurasian watermilfoil, but it does not affect the macroalgae *Nitella and Chara,* the beneficial plants that presently occur in the lake. Effects of fluridone treatment become noticeable within 7 to 10 days of application, with complete control often requiring 60 to 90 days.

Advantages and drawbacks of fluridone are the same as those described for glyphosate. An additional drawback of fluridone is that it requires that a large portion of the lake or the whole lake be treated to be effective. Therefore, it can not be used to target small zones and impacts some beneficial submerged plants as well as nuisance plants. For Lake Killarney it has been assumed that treatments would continue to occur on only one-third of the lake and that treatments would only occur on alternating years. Thus it could be from two to six years before any one area was re-treated. This has been estimated to cost $4,700 per treatment year. This cost is based on predicted 1997 chemical prices. The 10-year cost is estimated at $23,500.

Grass Carp

Grass carp are plant-consuming fish native to China and Siberia. Sterile (triploid) grass carp are raised in the southeast US for lake-wide, low-intensity control of submerged aquatic plants. Known for their high growth rates and wide range of food preference, these fish can control certain nuisance aquatic plants under the right circumstances. Stocking rates depend on climate, water temperature, type and extent of plant species, and other site-specific conditions. In 1990, Washington state adopted grass carp regulations that require the following conditions:

- Only sterile (triploid) fish can be planted.
- Inlets and outlets must be screened to prevent fish from getting into other water bodies.
- To insure sufficient vegetation is retained for fish and wildlife habitat, stocking rates are defined by WDFW based on the current planting model.
- Lakes with public access require a lake restoration study.

Effectiveness of grass carp in controlling aquatic plants depends on feeding preferences and metabolism. Recent laboratory and field studies in Washington state indicate that thin-leaved pondweeds and *Elodea canadensis* are highly preferred, broad leaf pondweed and milfoil are less preferred, and that waterlilies are generally not eaten. The primary advantage of grass carp is the low cost (if a lake restoration study has been performed). Primary drawbacks are that effects are unpredictable and that all beneficial plants may be removed, resulting in serious impacts to fish and wildlife.

Costs range from $50 to $2,000 per acre, at stocking rates ranging from 5 to 200 fish per acre and average cost of $10 per fish. The 10-year cost estimate is $5,000 based on a stocking rate of 50 fish per acre (500 fish to control 10 acres). However, additional costs would likely include more than $200,000 for an environmental checklist, lake restoration study, and outlet screening required by the fish planting permit. In addition to a game fish planting permit, hydraulic project approval is required by WDFW for installation of screens.

APPENDIX C

Do It Yourself Aquatic Plants Survey Handbook

APPENDIX C

Do It Yourself Aquatic Plants Survey Handbook

Prepared by: Lake Killarney Improvement Association

AQUATIC PLANT SURVEY METHODS
For Lakeside Property Owners

THE JOB

- to map types and locations of aquatic plants on the lake, preferably on an annual basis.

THE REASON

- to provide an ongoing record of both plant type and coverage over time.
- to add a valuable tool for detecting new species as they are introduced to the lake, such as Eurasian milfoil. etc.

THE TIME

- Aquatic plant mapping should be done at the same time each year so that variations in plant coverage can be more easily seen. August is the best month because plants are at their fullest development.
- Non-native, nuisance species such as Eurasian milfoil and purple loosestrife should, however, be monitored throughout the year.

THE EQUIPMENT

- a boat and safety equipment
- a wide bow rake on a long rope
- zip-lock bags and large garbage bags for over-size specimens
- waterproof marking pens
- clip board
- ice chest to receive labeled specimens
- plant identification books
- chart of previous year's plants
- map of lake
- 6-8 macrophyte mapping field sheets
- example sheets to help judge percent of cover
- colored marking pens to label lake map as to density and depth of species found
- weighted rope for measuring water depth
- plant press
- 3 people are advised in boat (boat operator, plant gatherer, and data taker)

HOW TO DO IT

- <u>Section off the lake map</u> as you proceed around the shore being guided by visual landmarks such as plant populations or shoreline geography. Number each section (the 1994 mapping of Lake Killarney split the lake into 14 sections).

- Do one lake section at a time and mark results on map. Enter the plant community type (emergent, floating, or submergent), percent of cover (0-25% light, 25-75% medium, and 75-100% heavy), plant species within the community type, and the estimated density within each community type on the field sheet. Include depth and distance from shore on the lake map as well as sediment types as noticed (mucky, sandy, gravel, etc.).

- Collect samples of aquatic plants that seem to be new to the lake and therefore not already in the lake archives. Submerged plants can be collected with a a wide bow rake cast from a boat at increasingly greater depths. The depth to which the submerged plants can be found should be confirmed by using the sounding lead.

Collect four samples of each new plant species found for permanent pressing and mounting. If possible, collect the whole plant specimen including roots, leaves, flowers and fruits.

Keep specimens moist by placing in plastic bags and storing in an ice-chest. Mark each sample in waterproof pen with species, date, location, habitat (e.g., water depth, color, other species present), name of collector, and any other information deemed relevant. Do not forget to make the appropriate notes on the lake map and field survey sheet.

Plant species that cannot be identified in the field can be referred to King County Surface Water Management or the state Department of Ecology for identification.

Highlight all locations on the lake map where Eurasian milfoil, parrotfeather milfoil and purple loosestrife, etc. are identified.

Take representative photos of unique species, general plant densities and identifying landmarks that can be used to tie it all together.

- All samples should be pressed as soon as possible after collection. Specimens should be arranged on a sheet of newspaper so that all essential botanical details (such as the number of leaves and the characteristics of the tops and bottoms of leaves) can be seen. Fruit and floral parts should be included. If they are too thick, such parts can be sliced both across and longitudinally.

Plants that are particularly thin-leaved or flimsy can be more easily arranged by floating them in a pan of water over typing paper. Use the paper to lift the specimen slowly out of the water. Place the sheet, plant and all, on newspaper and continue pressing as explained below.

After arranging the specimen on a sheet of newspaper, cover it with a second sheet. Place both sheets between blotter paper (which can be re-used) and place the sample into a plant press between two pieces of cardboard.

After all samples have been arranged, tighten the press and put it in a warm, dry place. Samples may take several days to dry.

Once dry, mount specimens on paper and label them with their scientific name, common name, location, habitat, date, name of collector and so on. Covering each page carefully with clear plastic can help to protect each specimen.

The collected specimens should then be stored in a cool, dry place. Check periodically for insects.