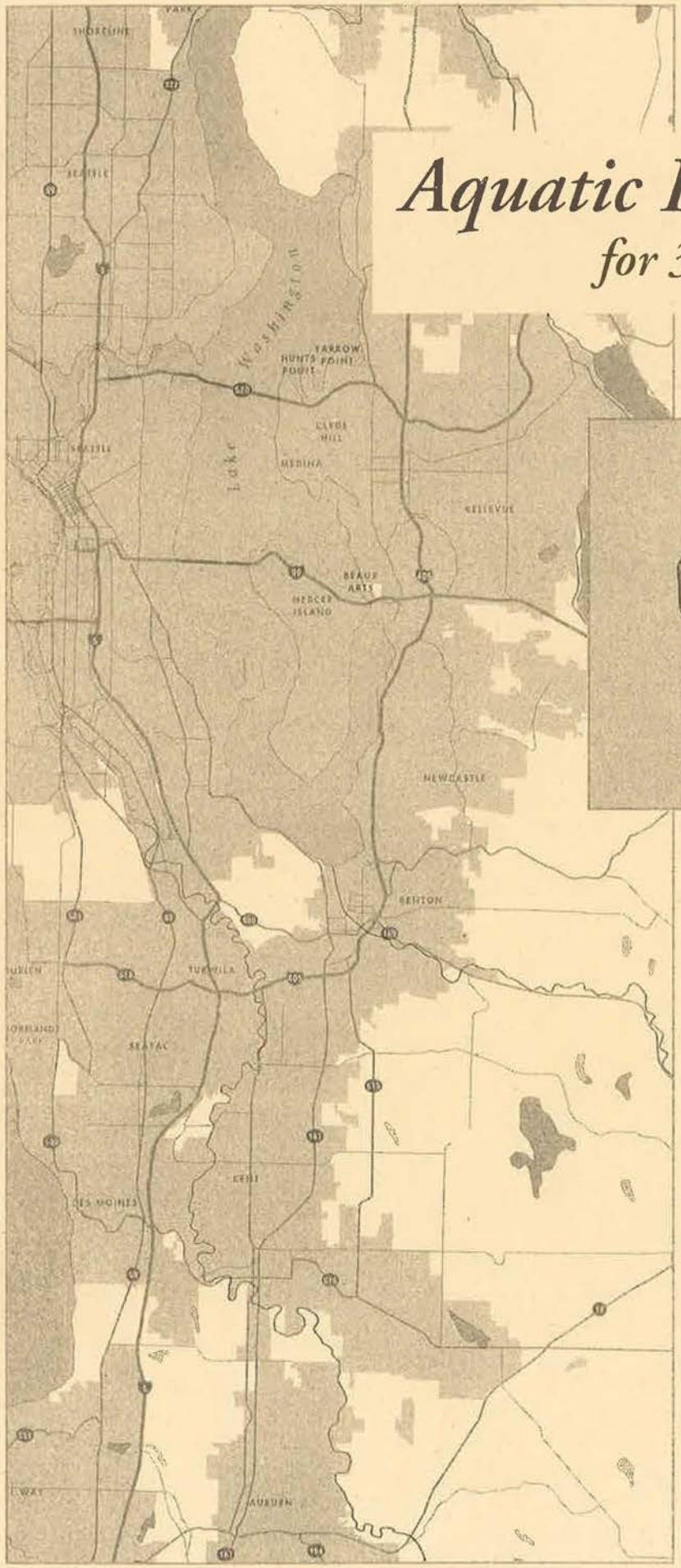
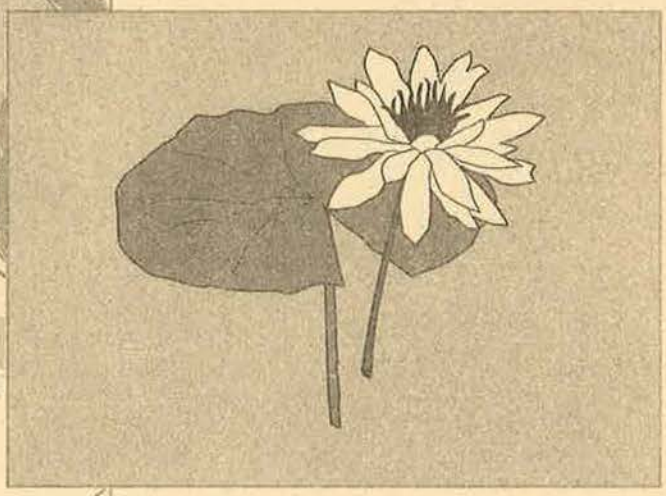


Aquatic Plant Mapping
for 36 King County Lakes

December 1996



King County Surface Water Management
Everyone lives downstream

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Aquatic Plant Mapping
for 36 King County Lakes

FINAL REPORT

Grant No. G9500310
December 1996

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This project could not have been completed without the support and work of numerous individuals. The opportunity to comprehensively map a lake's aquatic plant community is only available from about mid-July to approximately the end of August each year. The mapping project had the ambitious goal of covering 36 lakes over two summer periods, which required many long field days during these two periods. Special thanks go to Del Feild and Steve Majerick for their field work and technical support in keeping the project going and on schedule. Several pinch hitters also helped with the field work as needed including Nicholas Altieri, Wendy Cooke, Bill Priest, Bob Storer, and Sharon Walton. Bob Brenner and Kristen Kirby, King County Department of Metropolitan Services, assisted with the mapping effort on Lake Sawyer and Cassandra Robertson, United States Environmental Protection Agency, assisted in the mapping of North Lake.

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The project also required the collection and pressing of hundreds of plant specimens for creating herbariums for each lake. This entailed many more hours back in the office washing and pressing specimens. Wendy Cooke deserves special thanks for her numerous hours pressing and mounting the collected plant specimens. Her attention to detail, identification skills, and organization resulted in the development of the first King County aquatic plant herbarium. The specimens will provide a lasting record of the work performed and an assessment of plant species and distribution changes over time.

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Without the help of numerous volunteers the project would not have been possible. Volunteers worked with the field mapping team to learn about the plants in their lake as well as provided the project team with more accurate shoreline location information. Many volunteers also provided us access to the lake and/or the use of their private boats.

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- Gerri Baldwin (Killarney)
- Lee Johnson (McDonald)
- Del Hesseltine (Morton)
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- John Froelich (Retreat)
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- Janice Dugen (Twelve)
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Executive Summary

Executive Summary

This report represents the results of the 1994 and 1995 aquatic plant mapping project completed by the King County Surface Water Management (SWM) Division's Lake Stewardship Program. The project was partially funded through a Washington State Department of Ecology (WSDOE) Aquatic Weed Management Fund grant.

The primary goal of the project was to assess the existing and potential threats of invasive, non-native aquatic plants in King County lakes and secondly, to provide current information for developing overall aquatic plant management strategies for King County lakes. To meet these project goals, and provide better information for managing aquatic plants in King County, field and aerial aquatic plant surveys were conducted on 36 King County lakes during the summers of 1994 and 1995. The criteria used for selecting these lakes were as follows: (1) all public access and within the service area of the King County SWM Division; (2) an active community involved in volunteer monitoring and stewardship activities and within the service area and; and (3) public access lakes outside of the service area but within King County (six lakes only).

The field surveys were used to identify the species present, estimate their relative density, and assess the coverage of aquatic plants for the targeted lakes. The aerial surveys were designed to compliment the field surveys by providing detailed accurate delineation of lake shorelines and macrophyte beds for the targeted lakes.

Sixty species were recorded for the 36 lakes mapped during the course of the project. The list of aquatic plants documented on King County lakes included 27 emergent, five floating, and 28 submergent species and/or genera. The most frequently occurring emergent species included *Iris pseudacorus, Juncus sp., Potentilla palustris, Spiraea douglasii,* and *Typha latifolia. Nuphar lutea and Nymphaea odorata* were the most common floating plants and *Elodea canadensis, Najas flexilis, Nitella sp.*, and *Potamogeton pusillus* were the most common submergent plants.

Four listed noxious aquatic or emergent weeds were recorded: *Hydrilla verticillata, Lythrum salicaria, Myriophyllum spicatum,* and *Phalaris arundinacea. H. verticillata* was found in two lakes (Lucerne and Pipe); *L. salicaria* was found in 12 lakes (Alice, Cottage Desire, Dolloff, Kathleen, Killarney, Meridian, North, Panther, Pine, Pipe, and Spring); *M. spicatum* was found in 15 lakes (Bass, Desire, Dolloff, Killarney, Lucerne, Meridian, Neilson, Pipe, Sawyer, Shadow, Shady, Spring, Star, Twelve, Wilderness); and *Phalaris arundinacea* was noted on only two lake shorelines (Beaver

and Twelve). Of the 15 lakes with *M. spicatum* present, nine were infested prior to 1980 based on historical survey information.

The distribution of both *L. salicaria* and *M. spicatum* is known to be much broader in King County than indicated by the 12 lakes with *L. salicaria* and 15 lakes with *M. spicatum* present. For example, *M. spicatum* can be found in lakes Sammamish and Washington and *L. salicaria* can be found throughout the Bear Creek and May Creek watersheds. Thus, the distribution of these two species is only partially represented in King County by the 36 lakes which were surveyed as part of this project.

In King County the management of aquatic plants in lakes largely falls under the wetland regulatory framework. Twenty-six of the 36 lakes surveyed are classified as Class 1 or 2 wetlands, or have associated with the lake a Class 1 or 2 wetland system. Because of this wetland classification (or association), noxious weed removal is often the only available aquatic plant management option which is permitted in King County for many lakes.

The aquatic plant management recommendations developed from the completion of this project include: (1) review and modification of existing aquatic plant management policy in King County; (2) a prioritization of lakes impacted by noxious aquatic plants for integrated aquatic plant management plans (IAPMP); (3) a pilot program for training volunteers in noxious aquatic plant identification and monitoring; (4) a prioritization of lakes impacted by native plant populations for IAPMP; and (5) proposed small-scale aquatic plant management options for individual property owners. Integrated aquatic plant management often addresses problems with listed noxious, non-listed noxious, and occasionally native aquatic species. The current King County regulatory framework, which restricts aquatic plant management activities to listed noxious weed removal only, poses the biggest barrier to successful IAPMP and small scale aquatic plant management implementation when native species or non-listed noxious species require management. Review and modification of existing aquatic plant management policy in King County should be performed to facilitate the implementation of IAPMP recommendations and smaller scale aquatic plant management actions.

The citizens of Washington, in partnership with the WSDOE, have expended considerable effort to develop the IAPMP model as a tool to balance the complex management issues associated with aquatic plants. The model was developed largely in response to ongoing year-to-year aquatic plant management actions (i.e., repeated herbicide applications) which posed an increasing threat to the stability and health of the State's lakes. The IAPMP model brings together the different interest groups affected by the management of aquatic plants with a planning process designed to balance aquatic habitat as well as recreational values afforded by lake systems. Through this project, lakes impacted by noxious weed growth or excessive native

plant growth can use the IAPMP process as a tool to develop long-term management solutions.

Prevention of noxious weed infestation remains the most cost effective aquatic plant management tool. The proposed pilot volunteer training program would teach volunteers noxious weed identification and survey techniques. Volunteers would routinely survey their assigned lake for noxious aquatic weeds and new or unfamiliar plants. New noxious weed infestations could be identified early-on and eradication could likely be performed with the financial assistance of the Washington State Department of Ecology, before the infestations impact the entire aquatic plant community.

As the population of the region grows, recreational pressure will continue to be placed on King County's lakes. Increasingly, integrated aquatic plant management is needed to balance the diverse goals for providing aquatic habitat, good water quality, property owner aesthetics, and public recreational goals. Balancing these goals will require sustaining local lake stewardship activities which support the maintenance of a balanced plant community and involving both lakeside residents and lake users in the management of aquatic plants. Local government support will be key to the maintenance of balanced aquatic plant communities and the protection of beneficial uses associated with the region's lakes.

Chapter 1

Introduction

CHAPTER 1: INTRODUCTION

During the summers of 1994 and 1995, aquatic plant communities for 36 King County lakes were characterized and mapped as part of the Department of Public Works Surface Water Management (SWM) Division's Lake Stewardship Program (Figure 1). This report summarizes the results of the aquatic plant survey project. The report includes a background discussion of the project, discussion of the methods used to characterize the aquatic plant communities, results of the surveys, discussion of the individual lake survey results, and recommendations for future aquatic plant management activities in King County.

BACKGROUND

Increasingly, more King County lakes are being impacted by excessive aquatic plant growth. This excessive growth is, in part, fueled by additional nutrient delivery to lakes via soil erosion and domestic fertilizer use and, in part, by the continuing spread of non-native aquatic plant species. Complaints of poorer water quality and increasing volumes of aquatic plants are commonly heard from long-time lake residents. These complaints are antidotally correlated with the region's population increase and, for some lakes, can be documented based on historical data.

Prior to this project, the historical data regarding aquatic plant species and coverage for most King County lakes were 15 to 20 years old (Metro 1973, 1976, 1977, 19978, 1979, and 1980). This historical information remains a valuable reference in evaluating aquatic plant community compositional changes over time. However, given the dynamic nature of lake ecosystems, more current information has been needed to provide technical assistance to lake residents as well as to evaluate and plan for the aquatic plant management needs of the region's lakes.

Twenty-five percent of King County's lakes can be characterized as shallow (with an average depth of 13 feet or less). Shallow lakes, in turn, are more likely to experience aquatic plant management problems or develop problems with excessive plant growth over time. These lakes are more susceptible to developing nuisance aquatic plant problems because they have proportionately larger littoral (shallow) areas available for aquatic plant colonization. For these lakes, depth frequently does not the limit plant growth and changes to the lake bottom, increases in nutrient loading to the lake, or changes in water clarity can tip the balance, resulting in a lake dominated by aquatic plants.

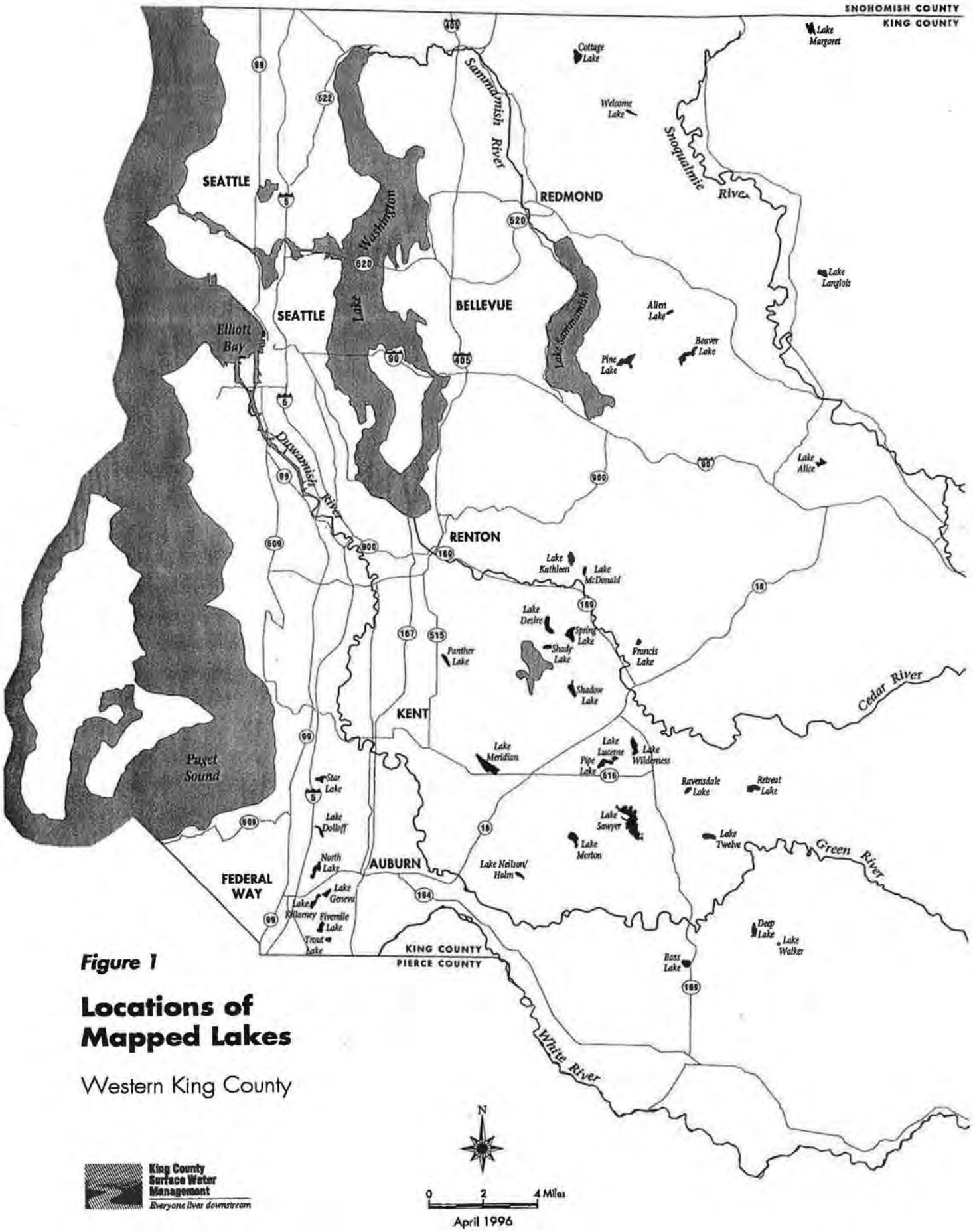

Figure 1

Locations of Mapped Lakes

Western King County

King County Surface Water Management
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Additionally, shallow lakes and shallow areas of deeper lakes are exceptionally susceptible to the problems associated with the introduction of non-native aquatic plants including *Myriophyllum spicatum* (Eurasian watermilfoil) and *Lythrum salicaria* (purple loosestrife). The impacts of both of these species to aquatic habitat and recreational uses of aquatic systems is well documented. Both species form monotypic stands and reduce the habitat quality for fish *(M. spicatum)* and waterfowl (*L. salicaria)*.

Lake Wilderness, which has an average depth of 21 feet, is an example of a lake impacted by a noxious species. *M. spicatum* was first documented in the lake during the 1994 survey. Since then it quickly spread throughout the lake by plant fragments. An IAPMP is currently being developed for Lake Wilderness to address the problem created by this plant species.

Deeper lakes can also be impacted in localized areas by excessive aquatic plant growth. Many lakes have shallow embayment areas which can be very suitable for plant growth. *Nymphaea odorota,* which has been introduced to many of the region's lake as an ornamental, can be particularly problematic in shallow shoreline areas where thick plant coverage reduces open water access for shoreline residents (i.e., Pine Lake).

PROJECT GOALS

The primary goal of the project was to assess the existing and potential threats of invasive, non-native aquatic plants in King County lakes and secondly, to provide current information for developing overall aquatic plant management strategies for King County lakes. To meet these project goals, and provide better information for managing aquatic plants in King County, field and aerial aquatic plant surveys were conducted on 36 King County lakes during the summers of 1994 and 1995. The field surveys were used to identify the species present, estimate their relative density, and assess the coverage of aquatic plants for the targeted lakes. The aerial survey was designed to compliment the field surveys by providing detailed accurate delineation of lake shorelines and macrophyte beds for the targeted lakes.

AQUATIC PLANT COMMUNITY TYPES

An aquatic plant is defined as "a plant that may, under normal conditions, germinate and grow with at least its base in the water and is large enough to be seen with the naked eye (Fasset, 1957)." Although this is a rather simple definition, it generally captures the group of plants limnologists commonly refer to as aquatics. Aquatic plants can also be categorized by four community types: (1) emergent; (2) floating rooted; (3) floating freely; and (4) submergent-rooted.

Emergents are those plants which are rooted in the sediment at the water edge but have stems and leaves which grow above the water surface. Common examples of emergents include cattails, rushes, and yellow iris. Floating rooted plants are rooted in the sediment and send leaves to the water's surface. The stems of these plants are usually flexible and have oval, heart, or circular shaped leaves. Common examples include waterlily and watershield. Freely floating plants are not rooted and float at the surface or in the water column of the lake. Examples include duckweed and bladderwort. The final group of aquatic plants are the submergents. These plants are found rooted in the lake bottom and grow within the water column. Some submergents may send their flower parts to the surface with stems and leaves remaining under water. The submergents are a very diverse group and include pondweeds, watermilfoil, coontail, and waterweed.

For management purposes, aquatic plants are also divided into two other categories: (1) native species; and (2) non-native (noxious or exotic) species. Native plants are those that have evolved and adapted naturally to an area. Moreover, native species usually do not become problematic because of the natural checks and balances present in the environment.

Non-native plants, on the other hand, have not evolved here and often become problematic because they have no natural checks (i.e., insects, fungus, and bacteria) which would serve to control their numbers. *Lythrum salicaria* (purple loosestrife) and *Myriophyllum spicatum* (Eurasian watermilfoil) are two examples of non-natives which have become established in King County. These two plants have become problematic because of their ability to reproduce very successfully and out compete existing native populations. Typically, diverse plant communities provide variation in physical structure and food source for the variety of aquatic organisms which utilize aquatic plants in their lifecycle. Many exotics, including *L. salicaria* and *M. spicatum*, form dense monotypic stands which reduce the aquatic habitat and recreational value of these impacted areas.

HISTORICAL INFORMATION

Extensive aquatic plant distribution surveys were conducted by the King County Department of Metropolitan Services (formerly the Municipality of Metropolitan Seattle [Metro]) during 1973, 1976, 1977, 1978, 1979, and 1980 (Metro, 1973, 1976, 1977, 1978, 1979, and 1980). The King County Wetlands Inventory (King County 1987 and 1990 update) also provides some historical information on plant communities for many King County lakes. Table 1 summarizes the historical Metro survey and King County wetlands inventory information available for the 36 lakes surveyed by the SWM Division during 1994 and 1995. The remaining historical information on aquatic plant distribution for King County lakes originates with individual consultants, University of Washington, or agency lake management studies.

During the 1976 Metro aquatic plant survey, 24 lakes were selected from a list of 33 lakes originally surveyed as part of a quality assessment of King County surface waters (Metro 1973). Of the 24 lakes surveyed during 1976, 19 were also included in the surveys completed by the SWM Division during 1994 and 1995. For the 19 lakes where historical survey information is available, a comparison of species composition and the changes in noxious weed distribution was completed.

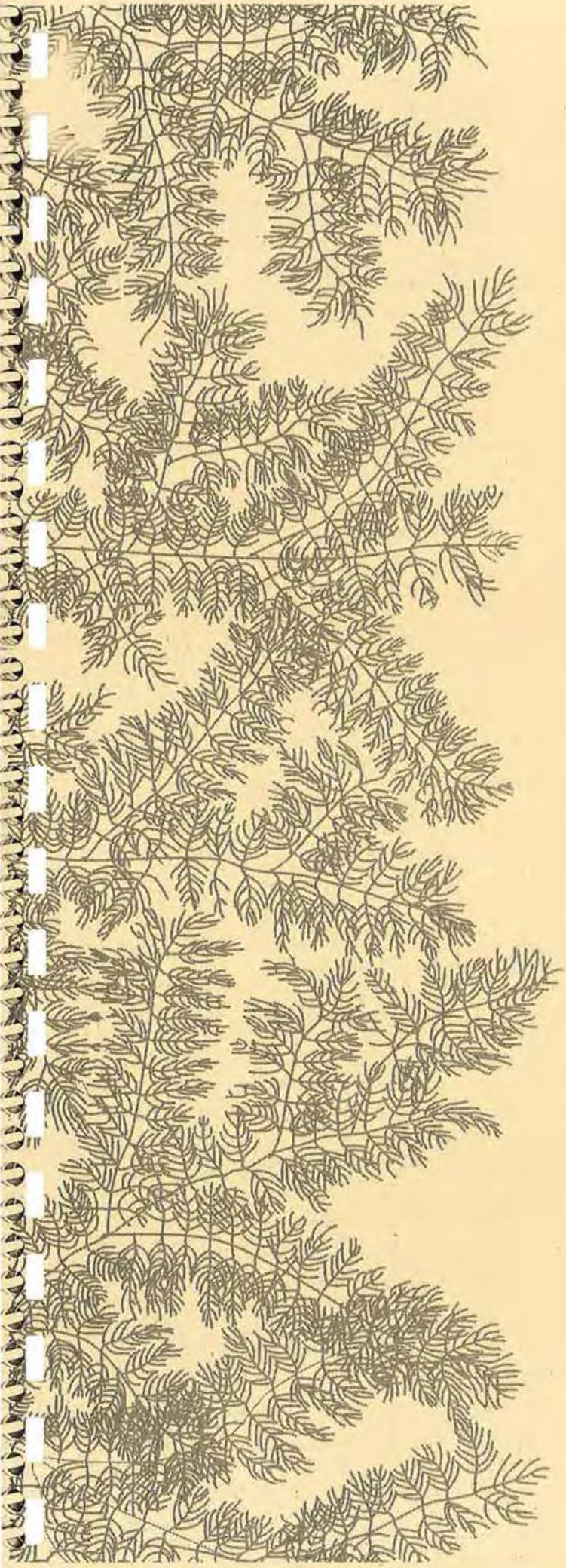
Other historical information on aquatic plant species, particularly emergent species, can be found throughout the King County Wetlands Inventory (1983 and 1990). Of the 36 lakes surveyed by the SWM Division, 26 have been classified as a Class 1 or 2 wetlands in the King County Wetlands Inventory (Table 1). Based on this classification system, a Class 1 wetland meets one or more of the following criteria: (a) presence of listed species (federal or state endangered or threaten species) or provides habitat for these species; (b) 40 to 60 percent of the area is open water with two or more vegetation classes; (c) ten acres or more in size and having three or more wetland classes including open water; and (d) the presence of plant associations of infrequent occurrence. A Class 2 wetlands meets the following criteria: (a) greater than one acre; (b) equal to or less than one acre but have three or more wetland classes; (c) equal to or less than one acre that have a forested wetland class; or (d) the presence of heron rookeries or raptor nesting trees.

Table 1: *Historical Aquatic Plant Data Availability by Lake from Metro Surveys* and King County Wetlands Inventory*

No.	Lake Name	Survey Year 1976	1977	1978	1979	1980	Wetland Ranking#
1	Alice						NR
2	Allen						1
3	Bass	x		x		x	NR
4	Beaver	x		x		x	1
5	Cottage	x		x			1
6	Deep	x		x		x	NR
7	Desire	x		x		x	1
8	Dolloff						1
9	Fivemile						2
10	Francis						1
11	Geneva						2
12	Kathleen	x		x			1
13	Killarney						2
14	Langlois						2
15	Lucerne						1
16	Margaret						NR
17	McDonald						1
18	Meridian	x	x	x	x	x	2
19	Morton	x		x			NR
20	Neilson (Holm)						2
21	North						2
22	Panther	x		x			1
23	Pine	x		x	x	x	1
24	Pipe	x		x			2
25	Ravensdale						2
26	Retreat	x		x			NR
27	Sawyer	x	x	x		x	NR
28	Shadow	x	x	x	x	x	1
29	Shady	x		x	x	x	NR
30	Spring	x	x	x		x	1
31	Star	x	x	x	x	x	NR
32	Trout						2
33	Twelve	x		x		x	2
34	Walker						NR
35	Welcome						2
36	Wilderness	x		x		x	2

* Metro 1976; 1977, 1978; 1979 and 1980

1=Class 1 wetland, 2=Class 2 wetland, and NR=not rated. See text discussion for explanation of criteria associated with Class 1 and 2 wetlands.



Chapter 2

Methods

CHAPTER 2: METHODS

LAKE SELECTION

Thirty-six lakes ranging in size from 11 to 272 acres in size were mapped in King County during the summers of 1994 and 1995. Table 2 lists the location, physical characteristics, and public access status for these surveyed lakes. Seventeen lakes were mapped during 1994 and 19 additional lakes were mapped in 1995 (Lake Killarney was mapped both during 1994 and 1995 because an integrated aquatic plant management plan was being developed for the lake). The criteria used for selecting these lakes were as follows: (1) all public access and within the service area of the King County SWM Division; (2) an active community involved in volunteer monitoring and stewardship activities and within the service area; and (3) public access lakes outside of the service area but within King County. Six lakes were selected from this third group to provide information on aquatic plant distribution in more rural King County lakes which could then be compared with the more urbanized lakes which comprised the majority of the surveyed lakes.

FIELD PREPARATION

For each lake, a project file was created. The file included historical aquatic plant mapping information if available, physical characteristics of the lake (Table 2), an aerial photograph of the lake, and a base map of the lake. Base maps were developed for each of the lakes prior to field surveying. Base maps showed the lake shoreline, depth contours of the lake, and shoreline properties. For some lakes, depth contour information was not available and was omitted from the field map.

Black and white aerial photographs were used to identify landmarks including docks and houses. These landmarks were sketched onto the base maps and were used as locators while in the field.

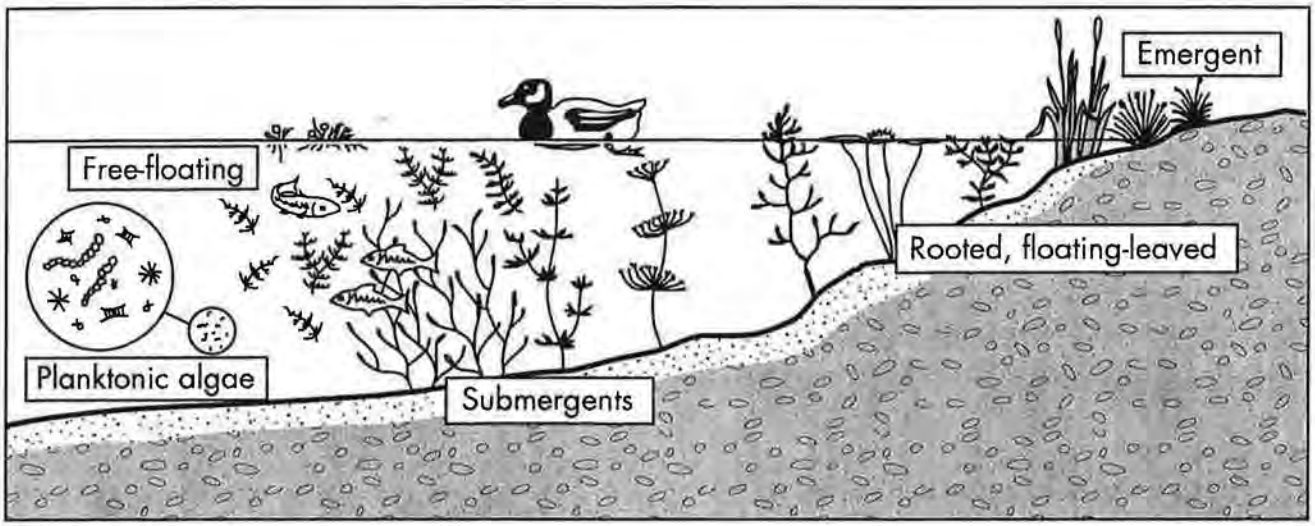
Table 2: *Lake Location and Physical Characteristics of Surveyed Lakes*

No.	Lake Name	Location	Watershed (acres)	Lake Area (acres)*	Mean Depth (feet)	Maximum Depth (Feet)	Public Park	Launch
1	Alice	2.5 miles S of Fall City	154	33.6	8	30	n	y
2	Allen	6 miles N of Issaquah	na	10.7	na	na	n	n
3	Bass	3.5 miles N of Enumclaw	1581	24.0	12	26	n	y
4	Beaver	5 miles W of Fall City	1043	68.9	21	54	y	y
5	Cottage	4 miles E of Woodinville	4371	64.0	15	25	y	y
6	Deep	0.75 miles SW of Cumberland	2509	37.5	33	74	y	y
7	Desire	5 miles SE of Renton	875	68.6	13	21	y	y
8	Dolloff	3 miles NW of Auburn	518	24.3	10	19	n	y
9	Fivemile	4 miles SW of Auburn	640	39.0	18	32	y	y
10	Francis	2 miles N of Maple Valley	390	15.4	4	9	n	n
11	Geneva	2.5 miles SW of Auburn	224	27.9	19	46	y	y
12	Kathleen	5.25 miles NW of Maple Valley	314	37.7	7	22	n	n
13	Killarney	3.5 miles SW of Auburn	154	29.3	9	15	n	y
14	Langlois	1.25 miles SE of Carnation	236	41.7	53	98	n	y
15	Lucerne	4.5 miles NW of Black Diamond	403.2	14.9	18	37	n	n
16	Margaret	4.25 miles NE of Duvall	1523	50.3	18	43	n	y
17	McDonald	6 miles E of Renton	96	17.1	23	47	n	n
18	Meridian	4 miles E of Kent	742	141.8	41	90	y	y
19	Morton	4 miles W of Black Diamond	256	65.5	15	23	n	y
20	Neilson (Holm)	4.75 miles E of Auburn	186	19.3	18	31	y	y
21	North	3 miles W of Auburn	486	57.5	14	34	y	y
22	Panther	3.5 miles NE of Kent	192	28.2	3	7	n	y
23	Pine	4 miles N of Issaquah	640	84.5	20	39	y	y
24	Pipe	4.5 miles NW of Black Diamond	314	57.4	27	65	n	n
25	Ravensdale	0.25 miles W of Ravensdale	915	16.3	4	14	n	y
26	Retreat	1.75 miles E of Ravensdale	1414	51.6	23	50	n	n
27	Sawyer	2 miles NW of Black Diamond	8300	272.1	26	58	y	y
28	Shadow	2.5 miles W of Maple Valley	450	55.8	22	45	n	y
29	Shady	3.5 miles NW of Maple Valley	220	18.8	21	40	n	y
30	Spring	3 miles NW of Maple Valley	450	69.1	19	32	y	y
31	Star	3 miles SW of Kent	378	33.4	25	50	n	y
32	Trout	4 miles SW of Auburn	979	19.2	17	27	n	y
33	Twelve	1.5 miles NE of Black Diamond	440	38.8	13	28	n	y
34	Walker	1.5 miles SE of Cumberland	314	12.6	31	54	n	y
35	Welcome	5 miles NE of Redmond	588	15.3	na	na	n	n
36	Wilderness	2.5 miles S of Maple Valley	420	56.9	21	38	y	y

n=no
y=yes
na= data not available

*Data Source 1995 RMI aerials, SWM GIS

Figure 2: *Aquatic Plant Community Types*



WSDOE, 1994

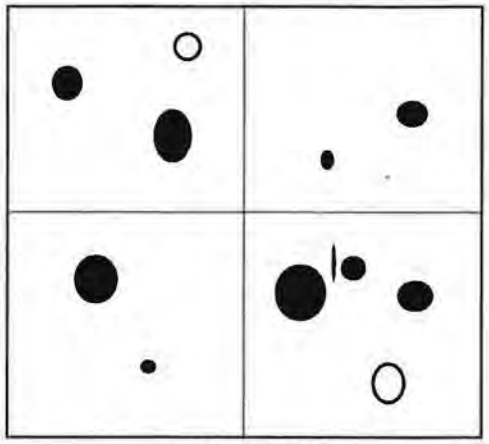
FIELD SURVEYING

All field surveys were conducted by boat using a two person crew plus a volunteer (or volunteers) when available. Prior to the start of the field survey, the Global Positioning System (GPS) unit was calibrated onsite and a position established at the boat launch or launch site to mark the beginning of the first lake shoreline section. A lake shoreline section was defined by the area between two arbitrarily chosen fixed shoreline points. The points were typically defined by fixed locations which included the launch site and distinct shoreline features(i.e., homes, docks, and geographic elements). After establishing visual endpoints for the shoreline section, a section number was assigned and recorded on the field notes before initiating the shoreline survey.

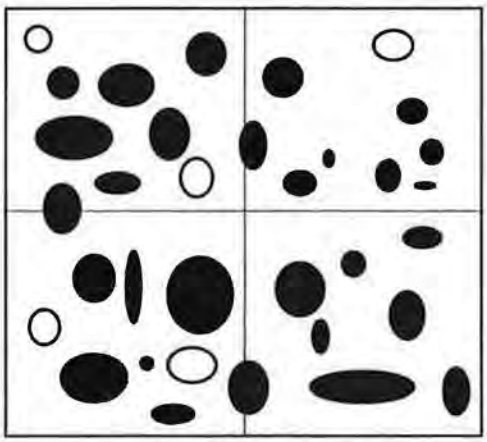
Each shoreline section was qualitatively characterized by community type, species present, percent cover of community type, and relative species density within a community type. To simplify the field survey, the community types used were reduced to emergent, floating, or submergent (Figure 2). Free-floating species such as bladderwort were characterized with the submergent community, while species like duckweed were included with the floating community.

Starting with the floating community, the beginning and ending depth for each community type was determined using a calibrated line and sounding lead, and recorded onto the field sheets. After identifying the species present within the community type, an estimate of percent cover was made for the community type. Three categories of percent cover (Figure 3), which included light (0-25% coverage), medium (25-75% coverage), and heavy (75-100% coverage), were used to describe

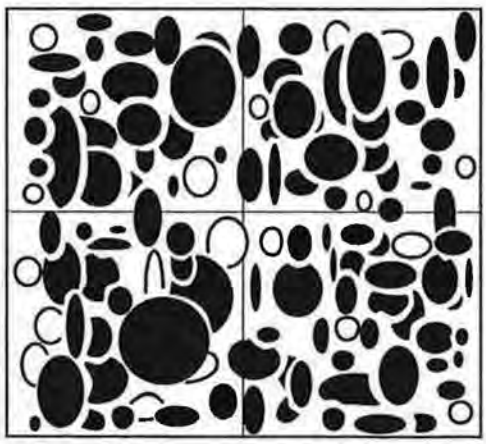
Figure 3:
Percent Cover Categories



Light (L): <25%

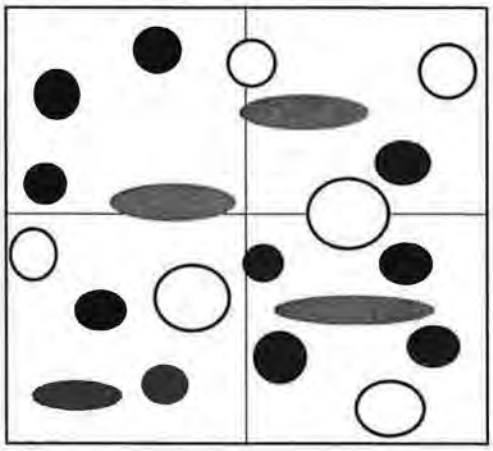


Medium (M): 25–75%



Heavy (H): >75%

Figure 4:
Species Density Determination Example



Specie A: 30%

Specie B: 50%

Specie C: 20%

the aquatic plant coverage. For each community type, species density was estimated to the nearest (10%) for the dominant species present (Figure 4).

Plant communities were sketched onto acetate transparencies overlaying the field maps or directly onto the field map using permanent markers. Multi-color hatching patterns were used to represent the three community types and three categories of percent cover (light, medium, and heavy). In addition to recording the locations of individual community types on the field map, the locations of all Eurasian watermilfoil and purple loosestrife infestations (two noxious species previously documented in King County lakes), were also highlighted. During 1995, after the discovery of *Hydrilla verticillata* in lakes Lucerne and Pipe, hydrilla was added to the list of non-natives to be highlighted if found. No additional hydrilla infestations were observed in the 1995 surveyed lakes.

The emergent and floating plant communities were easily characterized by visual observation from the surface. Submergent plants were identified through visual observation aided by using a viewing scope and dragging a bow rake along the lake bottom to retrieve plant specimens. The bow rake was cast into increasingly greater depths to confirm the edge of the submergent macrophyte bed. A sounding lead was then used to estimate the ending depth of the bed.

This qualitative mapping procedure was repeated for each shoreline section as the lake was circumnavigated. During the course of the mapping, Secchi depth was recorded and representative plant samples were collected. Four samples were collected for each specimen. An effort was made to obtain whole plants where practical and included the collection of stems, leaves, flowers, and roots. It was not always possible to collect all relative plant parts due to the timing of plant collection (immature or no flowers) or the large size of some plant parts (roots, tuber, or rhizome types). Plant samples were placed on ice in a cooler to preserve their quality. For plant samples which could not be identified in the field, additional samples were obtained and marked for later identification. These samples were numbered and recorded on the field sheets by their assigned number. The field notes were later updated to provide the proper identification of the originally unknown plant sample.

TRANSECTS

One or two representative locations were chosen for each lake to establish permanent transects for measuring changes in macrophyte community composition. Transects were established perpendicular to the shoreline using a 50 meter line. In areas where the macrophyte community extended beyond 50 meters, the line was extended to the edge of the submergent community. Using the sounding lead and GPS unit, the

beginning and ending depths and location for each community type were recorded along the transect line.

Using the GPS data dictionary, the lake name, date, and sampler information was entered into a standard lake information file. For each community type along a transect, the reference section, transect number, beginning and ending depth, community type (emergent, floating, or submergent), percent cover, plant species, and density were recorded. For each additional community type, the process was repeated until all communities along the transect had been delineated.

PLANT PRESSING AND MOUNTING

Collected plant specimens were sorted by species and three representative specimens were pressed. Known samples were labeled by lake name only while being pressed. Depending upon the number of samples and time available at the time of sample collection, unknown samples were either identified prior to pressing or identified after mounting. For all unknown samples, the assigned sample's number and lake name were included with the plant specimen until identification was completed.

After samples were dried, the specimens were mounted to herbarium paper using glue or adhesive tape. All samples were labeled with the following information: location, lake name, Latin name, common name, date collected, and name of collectors.

The plant specimens are currently housed in the King County Department of Natural Resource Surface Water Management Division (to renamed the Water and Land Resources Division in 1997) and are available for viewing, with an appointment. The herbarium is designed to serve as a resource to citizens, botanists, aquatic plant managers, and other individuals interested in the identification of aquatic plants in King County. The herbarium specimens are intended to serve as a permanent record of the plant species found in individual lakes in King County.

FIELD DATA REDUCTION

Field note species information was entered into an Access© database to develop and maintain species lists and print herbarium labels. A separate Geographic Information System (GIS) data base was developed to link lake section community and species descriptive information to the final lake maps.

AERIAL MAPPING

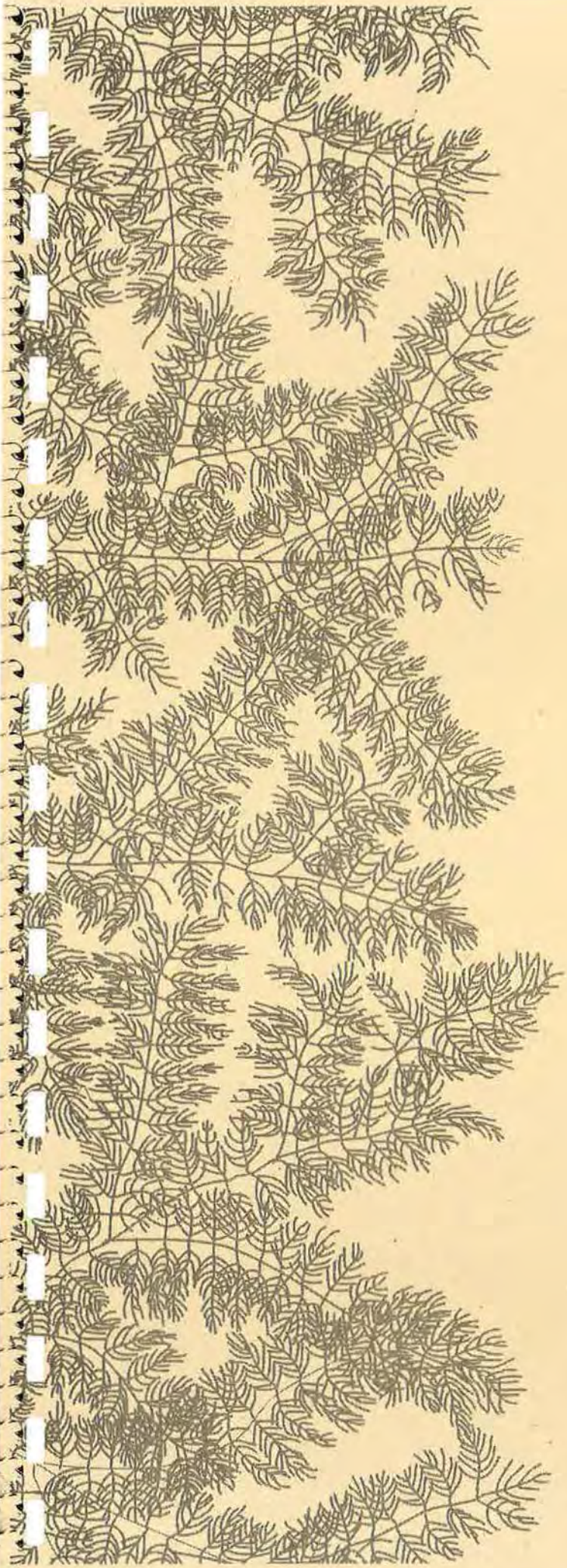
Aerial mapping methods are detailed in the consultant report (Resource Management, Inc. 1996) and are only briefly summarized in this section. Existing SWM aerial photographs (1989), SWM field data, and GPS data points were used by the project consultant in conjunction with new aerial photography collected for the project. The aerial images for each lake were collected using hyperspectral video and color imagery taken with fine grained color print film. The hyperspectral video camera system was calibrated to allow penetration of the target lake and the maximum separation of the submergent community based on water clarity.

The video and still photographic images collected by the consultant were converted to digital format and manipulated via computer to form scaled photo mosaics. These mosaics were geo-referenced to GPS data points collected during the field operation. For lakes Dolloff, Meridian, Panther, Shadow, Shady, Spring, Twelve, Walker, and Welcome sufficient data points were not available so the lakes were geo-referenced to the existing SWM GIS base files for the lakes. These photo mosaics were used to delineate the shoreline, emergent, floating, and submergent plant communities and then digitized and converted to ArcInfo© GIS file format. These files formed the base aquatic plant maps for the 36 lakes.

SWM staff added shoreline section breaks and the location of *Myriophyllum spicatum* and *Lythrum salicaria* from field maps to these base maps. The total acreage of the shoreline, and emergent, floating, and submergent plant communities were also determined by SWM staff from GIS base files.

FINAL MAPS/PLAN PRODUCTION

The GIS map files were imported into Adobe Illustrator© and standardized to a single format for the final report. The revised maps were then imported into Pagemaker© for final plan production.



Chapter 3

Results

CHAPTER 3: RESULTS

SUMMARY

Thirty-six lakes were mapped for aquatic plants during the summers of 1994 and 1995. Sixty species were recorded, 27 emergent, five floating, and 28 submergent species and/or genera (Table 3). The most frequently occurring (present in 25 lakes or more) emergent species included *Iris pseudacorus, Juncus sp., Potentilla palustris, Spiraea douglasii,* and *Typha latifolia. Nuphar lutea and Nymphaea odorata* were the most common floating plants and *Elodea canadensis, Najas flexilis, Nitella sp.*, and *Potamogeton pusillus* were the most common submergent plants.

Table 3: *King County Lake Species List and Frequency Found in Surveyed Lakes*

Species Name	Abbrev.	Common Name	Community	
Alisma gramineum	Ag	Water Plantain	Emergent	1
Angelica sp.	As	Angelica	Emergent	1
Brasenia schreberi	Bs	Water Shield	Floating	18
Callitriche sp.	Cp	Water Starwort	Submergent	4
Carex sp.	Ca	Sedge	Emergent	9
Ceratophyllum demersum	Cd	Coontail	Submergent	14
Chara sp.	Cs	Muskgrass	Submergent	22
Dulichium arundinaceum	Da	Three-way Sedge	Emergent	5
Eleocharis sp.	El	Spike Rush	Emergent	8
Elodea canadensis	Ec	Water Weed	Submergent	27
Equisetum sp.	Es	Horse Tail	Emergent	3
Fontinalis sp.	Fo	Water Moss	Submergent	4
Hippuris vulgaris	Hi	Mare's Tail	Submergent	1
Hydrilla verticillata	Hv	Hydrilla	Submergent	2
Hydrocotyle sp.	Hs	Water Pennywort	Emergent	3
Iris pseudacorus	Ip	Yellow Iris	Emergent	32
Isoetes sp.	Is	Quillwort	Submergent	4
Juncus sp.	Ju	Rush	Emergent	33
Ledum groenlandicum	Lg	Labrador Tea	Emergent	5
Lemma minor	Lm	Common or Lesser Duck Weed	Floating	2

Table 3: *King County Lake Species List and Frequency Found in Surveyed Lakes, continued*

Species Name	Abbrev.	Common Name	Community	Frequency
Ludwigia palustris	Lp	False Loosestrife	Emergent	22
Lysichitum americanum	Lc	Skunk Cabbage	Emergent	2
Lythrum salicaria	Ls	Purple Loosestrife	Emergent	12
Mentha sp.	Mp	Mint	Emergent	3
Menyanthes trifoliata	Mt	Buck Bean	Emergent	3
Myriophyllum sp.	My	Milfoil	Submergent	5
Myriophyllum spicatum	Ms	Eurasian Water Milfoil	Submergent	15
Najas flexilis	Nf	Bushy Pondweed	Submergent	25
Nitella sp.	Ni	Stonewort	Submergent	27
Nuphar lutea	Nl	Yellow Pondlily	Floating	28
Nymphaea odorata	No	Fragrant White Pondlily	Floating	27
Phalaris arundinacea	Pd	Reed Canary Grass	Emergent	2
Polygonum sp.	Pm	Smartweed	Emergent	11
Potamogeton alpinus	Pl	Pondweed	Submergent	1
Potamogeton amplifolius	Pa	Large Leafed Pondweed	Submergent	21
Potamogeton pusillus	Pb	Small Pondweed	Submergent	27
Potamogeton crispus	Pc	Curly Leafed Pondweed	Submergent	2
Potamogeton epihydrus	Pe	Ribbon Leafed Pondweed	Submergent	15
Potamogeton gramineus	Pg	Variable Pondweed	Submergent	1
Potamogeton illinoensis	Ps	Illinois Pondweed	Submergent	1
Potamogeton natans	Pn	Brown Leafed Pondweed	Submergent	2
Potamogeton pectinatus	Pt	Sago Pondweed	Submergent	1
Potamogeton praelongus	Pr	White-Stemmed Pondweed	Submergent	1
Potamogeton richardsonii	Pi	Richards Pondweed	Submergent	6
Potamogeton robbinsii	Po	Robbins Pondweed	Submergent	3
Potamogeton zosteriformis	Pz	Flat Stemmed Pondweed	Submergent	5
Potentilla palustris	Pp	Marsh Cinquefoil	Emergent	27
Ranunculus sp.	Rs	Buttercup	Submergent	2
Sagittaria sp.	Sa	Arrowhead	Emergent	4
Scirpus sp.	Sb	Bulrush	Emergent	11
Solanum sp.	Sn	Nightshade	Emergent	3
Sparganium sp.	Sf	Bur Weed	Emergent	5
Spiraea douglasii	Sd	Hardhack	Emergent	36
Spirodela polyrhiza	Sp	Large Duckweed	Floating	1
Typha angustifolia	Ta	Cat Tail	Emergent	1
Typha latifolia	Tl	Cat Tail	Emergent	30
Utricularia minor	Um	Bladderwort	Submergent	2
Utricularia sp.	Us	Bladderwort	Submergent	10
Utricularia vulgaris	Uv	Bladderwort	Submergent	9
Veronica sp.	Vs	Speedwell	Emergent	3

Table 4: *Aquatic Plant Coverage by Community Type*

Lake	Emergent Cover (acres)	Floating Cover (acres)	Submergent Cover (acres)	Total* Cover (acres)	Lake Size (acres)	Percent Coverage*	Average Depth (feet)
Alice	0.1	0.7	29.8	30.5	33.6	91%	8
Allen	2.5	0.8	1.3	2.2	10.7	19%	na
Bass	0.6	5.2	6.3	11.5	24	48%	12
Beaver	0.0	6.3	6.3	12.6	68.9	18%	21
Cottage	3.2	6.4	3.9	10.3	64	16%	15
Deep	0.0	0.0	4.3	4.3	37.5	12%	33
Desire	0.8	3.0	13.0	16.0	57.2	28%	13
Dolloff	0.9	3.6	5.8	9.4	24.3	39%	10
Fivemile	1.1	5.7	3.5	9.2	39	24%	18
Francis	2.7	8.8	6.4	15.2	15.4	99%	4
Geneva	0.0	3.4	6.8	10.2	27.9	36%	19
Kathleen	0.7	11.4	8.6	19.9	37.7	53%	7
Killarney	1.1	2.1	23.8	25.9	29.3	88%	9
Langlois	0.0	0.2	0.0	0.2	41.7	1%	53
Lucerne	0.1	2.4	4.1	6.5	14.9	44%	18
Margaret	0.0	0.0	9.6	9.6	50.3	19%	18
McDonald	0.3	2.3	2.9	5.2	17.1	30%	23
Meridian	1.1	5.3	25.4	30.6	141.8	22%	41
Morton	0.1	1.4	0.0	1.4	65.5	2%	15
Neilson (Holm)	3.8	2.1	2.6	4.7	19.3	24%	18
North	2.1	14.4	20.7	35.1	57.4	61%	14
Panther	6.5	22.8	4.8	27.6	28.2	98%	3
Pine	0.4	1.7	15.7	17.4	84.5	21%	20
Pipe	0.3	8.0	5.2	13.2	57.4	23%	27
Ravensdale	0.6	0.9	12.9	13.8	16.3	84%	4
Retreat	0.0	2.9	11.7	14.6	51.6	28%	23
Sawyer	1.3	8.9	65.7	74.6	272.1	27%	26
Shadow	0.8	3.2	2.6	5.9	55.8	11%	22
Shady	0.0	1.0	2.7	3.8	18.8	20%	21
Spring	1.8	2.1	13.8	15.9	69.1	23%	19
Star	0.4	1.7	7.7	9.4	33.4	28%	25
Trout	0.2	1.7	2.9	4.6	19.2	24%	17
Twelve	0.0	11.6	17.6	29.2	38.8	75%	13
Walker	0.0	0.0	0.0	0.0	12.6	0%	31
Welcome	0.5	0.1	3.4	3.5	15.3	23%	na
Wilderness	0.7	0.2	19.5	19.7	56.9	35%	21
Min	0.0	0.0	0.0	0.0	10.7	0%	3.0
Max	6.5	22.8	65.7	74.6	272.1	99%	53.0
Average	1.0	4.2	10.3	14.5	47.4	36%	18.9

Notes: Data Source 1995 RMI aerials, SWM GIS *Excludes Emergent Plant Coverage

Four noxious aquatic weeds were recorded including *Hydrilla verticillata, Lythrum salicaria, Myriophyllum spicatum* and *Phalaris arundinacea. H. verticillata* was found in two lakes (Lucerne and Pipe), *L. salicaria* was found in 12 lakes (Alice, Cottage Desire, Dolloff, Kathleen, Killarney, Meridian, North, Panther, Pine, Pipe, and Spring) *M. spicatum* was found in 15 lakes (Bass, Desire, Dolloff, Killarney, Lucerne, Meridian, Neilson, Pipe, Sawyer, Shadow, Shady, Spring, Star, Twelve, Wilderness) and *P. arundinacea* was found in two lakes (Beaver and Twelve).

Lake size and aquatic plant coverage by community type is summarized in Table 4. The smallest lake surveyed was Allen Lake at 10.7 acres, while Lake Sawyer at 272.1 acres was the largest. The average size of the surveyed lakes was 47.4 acres. Emergent plant coverage averaged one acre per lake with Panther Lake having the maximum emergent plant coverage at 6.5 acres. Floating plant coverage averaged 4.2 acres with Panther Lake again having the maximum coverage at 22.8 acres. Submergent plant coverage averaged 10.3 acres per lake. Lake Sawyer had 65.7 acres of submergent plant coverage, the maximum level observed for the surveyed lakes.

Results by Lake

Alice

Alice Lake was surveyed on August 21, 1995. Sky conditions were sunny. Secchi depth was not recorded. Sixteen plant species (listed below) were identified including 11 emergent types, three floating types, and two submergent types. The floating plant coverage totaled only 0.7 acres while the submergent community comprised 29.8 acres. In most sections, the submergent percent cover was less than 25 percent. Sections 1 and 2 contained wetland vegetation along the shoreline while sections 3, 4, and 5 comprised the developed shoreline area. Two small clumps of *Lythrum salicaria* were noted during the survey and should be targeted for removal before it spreads further.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Brasenia schreberi	Bs	Nuphar lutea	Nl
Dulichium arundinaceum	Da	Nymphaea odorata	No
Iris pseudacorus	Ip	Potamogeton pusillus	Pb
Juncus sp.	Ju	Potamogeton epihydrus	Pe
Ledum groenlandicum	Lg	Potentilla palustris	Pp
Ludwigia palustris	Lp	Spiraea douglasii	Sd
Lythrum salicaria	Ls	Typha latifolia	Tl
Menyanthes trifoliata	Mt	Veronica sp.	Vs

SPECIES PRESENT IN EACH SECTION

1 ..... Ip, Sd, Ju, Lp, Da, Mt, Lg, Ls, No, Bs, Nl, Pb, Pe

2 ..... Sd, Ip, Mt, Da, Ju, Tl, No, Nl, Bs, Pb, Pe

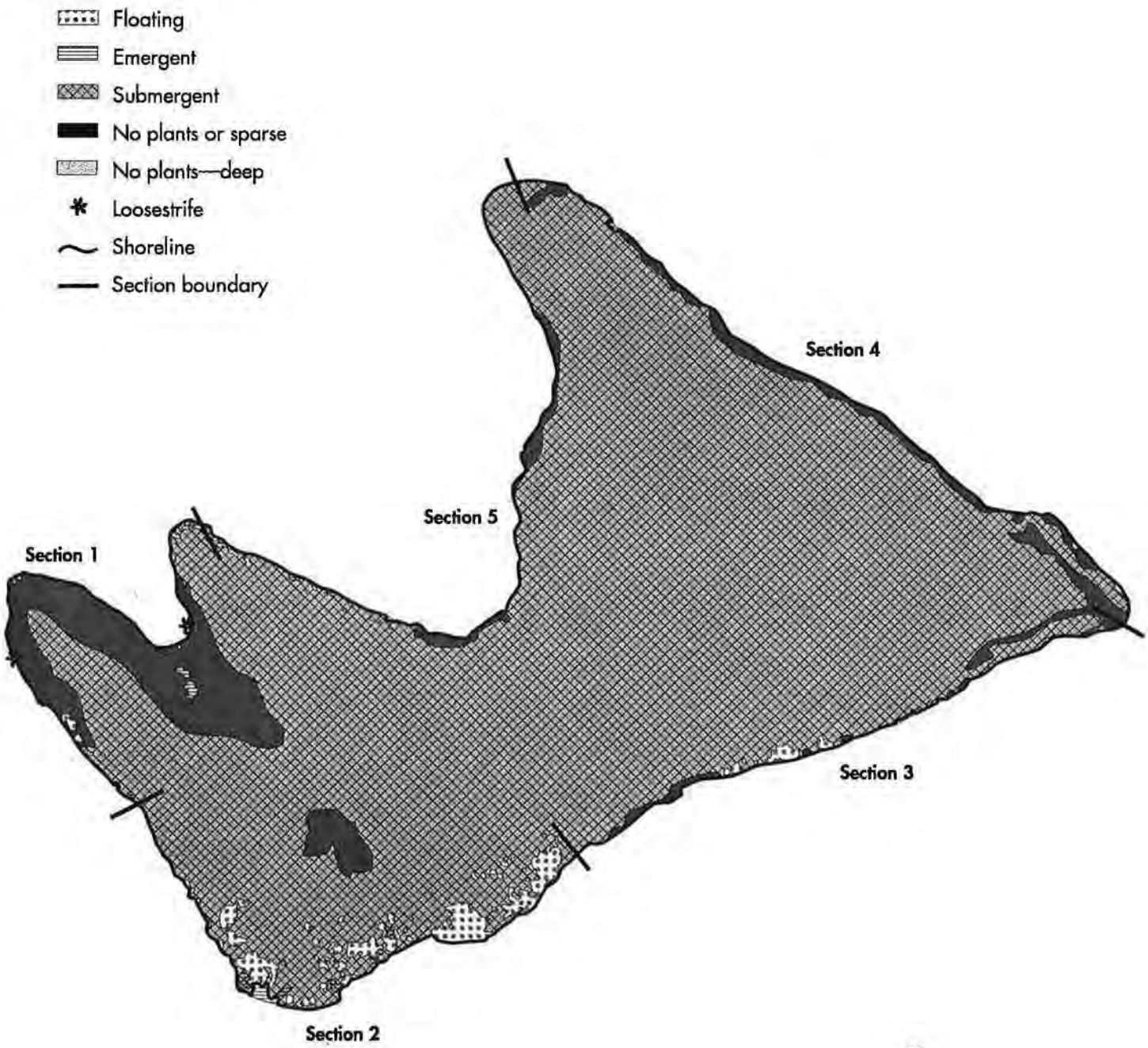
3 ..... Ip, Ju, Tl, Sd, Mt, No, Bs, Pe

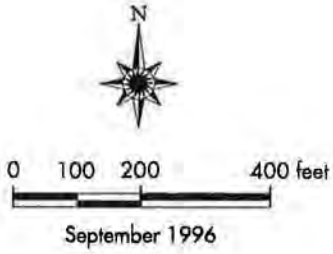
4 ..... Sd, Ju, Ip, Mt, Lg, Tl, Pp, Lp, No, Bs

5 ..... Tl, Sd, Mt, Pp, Ju, Ip, Da, Nl, No

Alice

Aquatic Plants Map





Lake Area: *33.6 acres*
Mean Depth: *8 feet*
Maximum Depth: *30 feet*

Allen

Allen Lake was surveyed on August 7, 1995. The survey team was assisted by Allen Lake resident Dave Burton. Secchi depth was 0.8 meters and the water was highly colored by organic acids. The weather during the survey was rainy. Sixteen plant species (listed below) were identified including ten emergent types, one floating type, and five submergent types. The floating plant coverage totaled 0.8 acres while the submergent community comprised 1.3 acres. In most sections, percent cover was typically less than 25 percent for floating and submergent communities. The dark water color is probably the most influential environmental factor limiting the growth of submergent plants in Lake Allen. Emergent vegetation ranged from 25 to 75 percent cover with very little development along the shoreline.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Callitriche sp.	Cp	Nuphar lutea	Nl
Ceratophyllum demersum	Cd	Polygonum sp.	Pm
Iris pseudacorus	Ip	Potamogeton pusillus	Pb
Juncus sp.	Ju	Potamogeton epihydrus	Pe
Ludwigia palustris	Lp	Potentilla palustris	Pp
Lysichitum americanum	Lc	Solanum sp.	Sn
Najas flexilis	Nf	Spiraea douglasii	Sd
Nitella sp.	Ni	Typha latifolia	Tl

SPECIES PRESENT IN EACH SECTION

1 ..... Ip, Tl, Sd, Ju, Pp, Sn, Nl, Cd, Cp, Pe, Pb

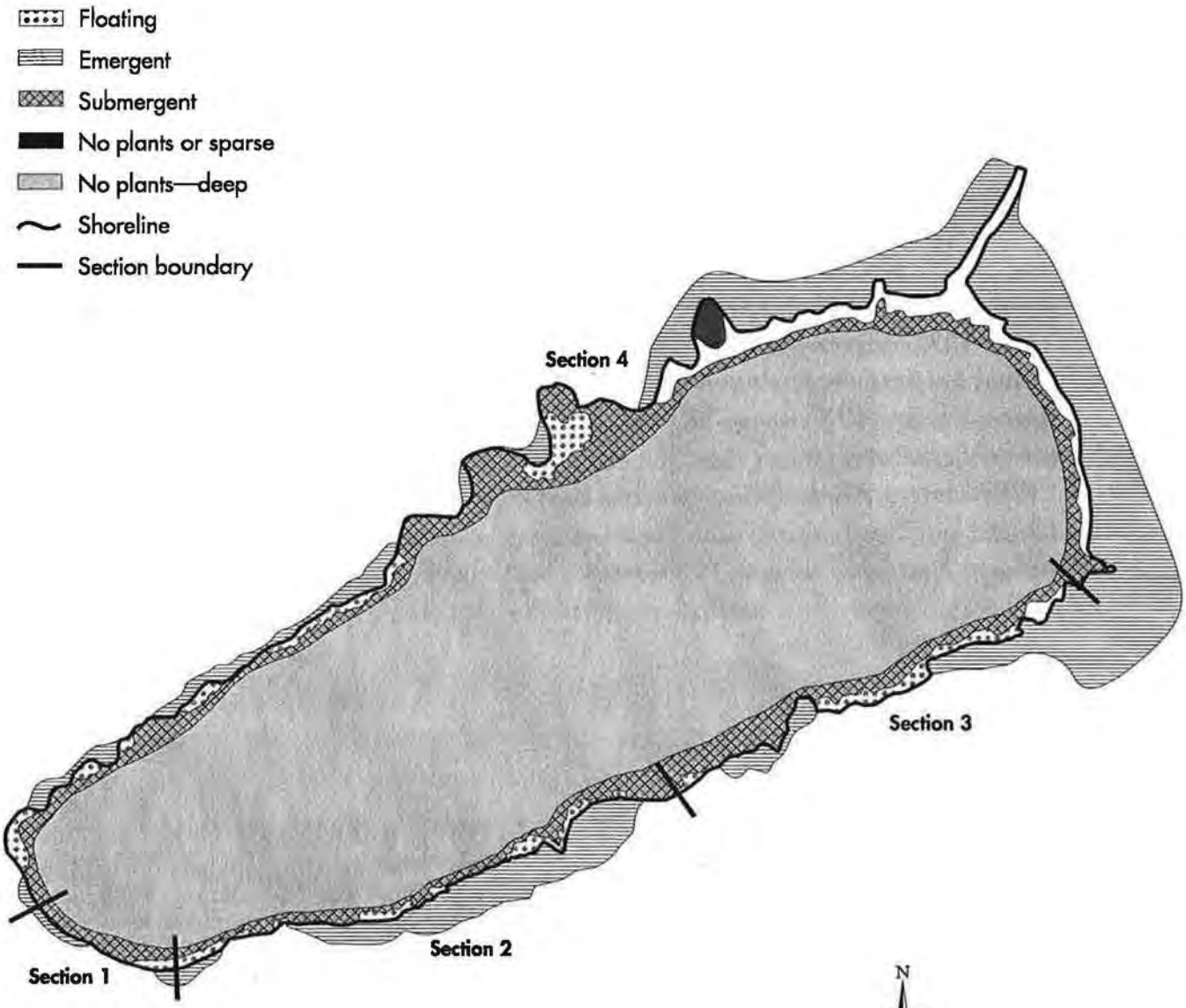
2 ..... Ip, Sd, Sn, Lp, Pm, Ju, Nl, Cd, Pb, Pe

3 ..... Sd, Ip, Ju, Tl, Pp, Dv, Nl, Cd, Pb

4 ..... Sd, Ip, Ju, Tl, Pp, Pm, Nl, Cd, Pe, Ni, Nf

Allen

Aquatic Plants Map



September 1996

Lake Area: *10.7 acres*
Mean Depth: *Data not available*
Maximum Depth: *Data not available*

Bass

Bass Lake was surveyed on July 25, 1995. Secchi depth was 2.0 meters. Surface accumulation of algae was present at the edge of lake at the time of the survey. Sky conditions were sunny during the survey. Seventeen plant species (listed below) were identified including nine emergent types, two floating types, and six submergent types. The floating plant coverage totaled 5.2 acres while the submergent community comprised 6.3 acres. Throughout the vegetated part of the lake, percent cover was greater than 75 percent for all community types. *Myriophyllum spicatum* was the dominant plant species in the submergent community.

Bass Lake was surveyed during the 1976, 1977, 1978 and 1980 Metro surveys (Metro 1976, 1977, 1978 and 1980). *Myriophyllum spicatum* was observed in all previous surveys. With the exception of the 1977 survey, the density of plants in previous surveys was described as dense, forming a band of aquatic vegetation to a depth of nine feet. The cause of the reduction in plant growth observed during 1977 was not known. In the 1995 SWM survey, the submergent community was very dense with greater than 75 percent cover and extended to a depth of 11 feet. Since the 1970s' surveys, *Myriophyllum spicatum* has become the predominant submergent plant and is no longer significantly mixed with *Potamogeton sp.* as indicated by past surveys. *Najas flexilis, Nitella sp., Nymphaea odorata, Potamogeton pusillus,* and *Spirodella polyrhiza* were species observed in historical surveys but were not observed during the 1995 SWM survey.

SPECIES PRESENT AND THEIR ABBREVIATIONS

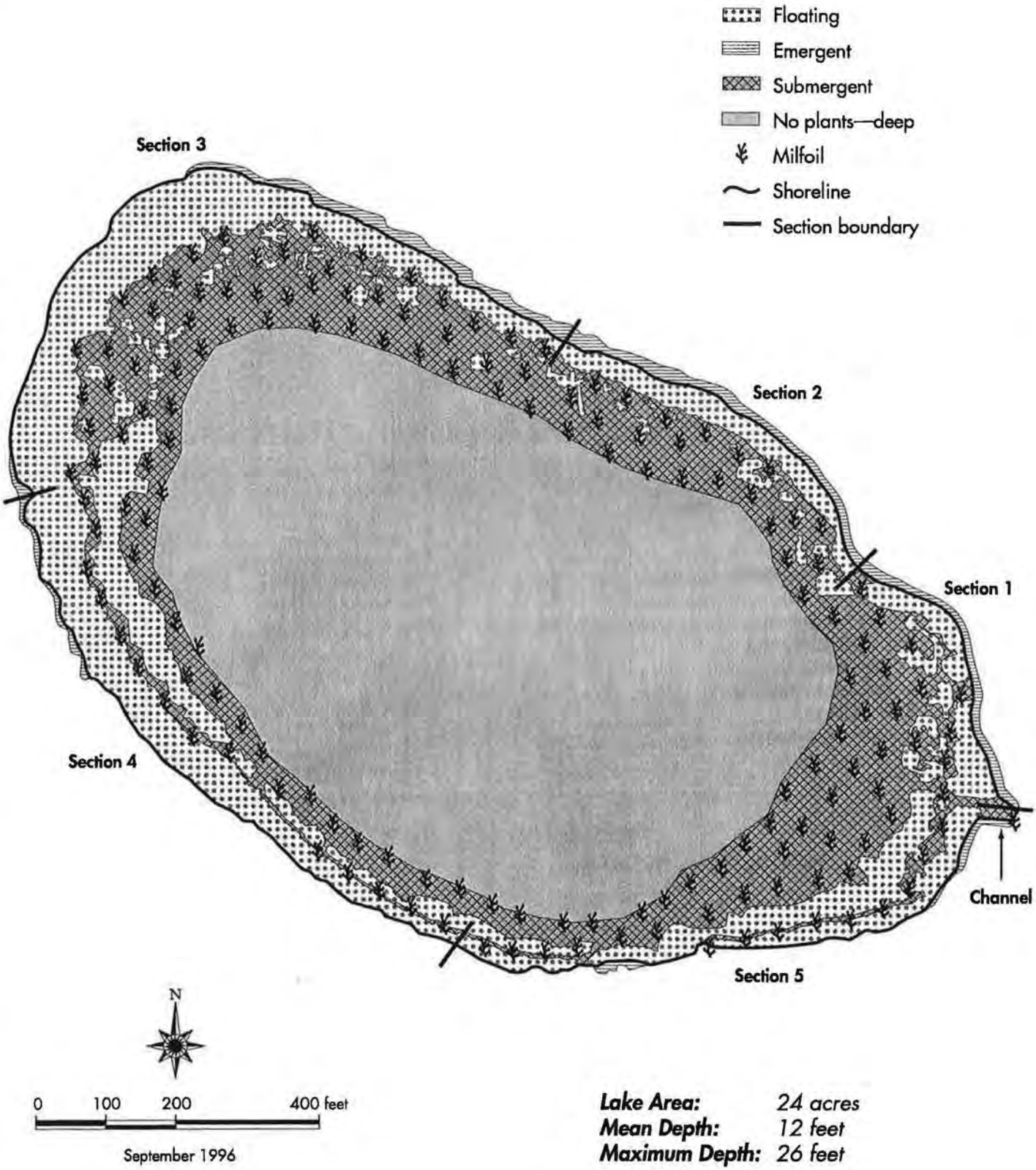
Brasenia schreberi	Bs	Nuphar lutea	Nl
Carex sp.	Ca	Polygonum sp.	Pm
Ceratophyllum demersum	Cd	Potamogeton amplifolius	Pa
Elodea canadensis	Ec	Potamogeton zosteriformis	Pz
Hydrocotyle sp.	Hs	Potentilla palustris	Pp
Juncus sp.	Ju	Spiraea douglasii	Sd
Ludwigia palustris	Lp	Typha latifolia	Tl
Myriophyllum sp.	My	Utricularia vulgaris	Uv
Myriophyllum spicatum	Ms		

SPECIES PRESENT IN EACH SECTION

1	Tl, Pp, Pm, Bs, Nl, Pa, Ms, Ec, Cd, Pz, Uv
2	Tl, Pp, Pm, Bs, Nl, Pa, Ms, Ec, Pz, Uv, Cd
3	Pp, Tl, Pm, Sd, Bs, Nl, Pa, Ms, Ec, Cd, Pz, Pm
4	Tl, Pp, Pm, Sd, Ju, Bs, Nl, Ms, Pa, Pz, Ec, Cd, Uv
5	Ju, Sd, Ca, Pp, Tl, Pm, Bs, Nl, Pa, Pz, Ms, Ec, Uv
Channel	Tl, Pp, Pm, Hs, Lp, Ms, Ec

Bass

Aquatic Plants Map



September 1996

Lake Area: *24 acres*
Mean Depth: *12 feet*
Maximum Depth: *26 feet*

Beaver

Beaver Lake was surveyed on August 2, 1995. The survey team was assisted by Beaver Lake residents Carolyn and John Lesh. Secchi depth was 1.5 meters in Beaver Lake 1 (small, north basin) and 2.5 meters in Beaver Lake 2 (large, southern basin). The water was clear but highly colored by organic acids from watershed wetlands. Sky conditions were partly cloudy during the survey. Twenty-nine plant species (listed below) were identified including 14 emergent types, three floating types, and 12 submergent types. The floating plant coverage totaled 6.3 acres while the submergent community also comprised 6.3 acres. In most sections, percent cover was typically less than 25 percent. Section 6 (Beaver Lake 1) showed moderate coverage (between 25 and 75 percent) of floating and submergent communities. Emergent vegetation coverage was fairly limited by shoreline development or the presence of terrestrial vegetation for many areas of the lake as shown in the map.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Alisma gramineum	Ag	Nuphar lutea	Nl
Brasenia schreberi	Bs	Nymphaea odorata	No
Ceratophyllum demersum	Cd	Phalaris arundinacea	Pd
Chara sp.	Cs	Polygonum sp.	Pm
Eleocharis sp.	El	Potamogeton amplifolius	Pa
Elodea canadensis	Ec	Potamogeton pusillus	Pb
Fontinalis sp.	Fo	Potamogeton epihydrus	Pe
Hydrocotyle sp.	Hs	Potamogeton crispus	Pc
Iris pseudacorus	Ip	Potamogeton robbinsii	Po
Juncus sp.	Ju	Potentilla palustris	Pp
Ludwigia palustris	Lp	Scirpus sp.	Sb
Mentha sp.	Mp	Spiraea douglasii	Sd
Myriophyllum sp.	My	Typha latifolia	Tl
Najas flexilis	Nf	Utricularia vulgaris	Uv
Nitella sp.	Ni		

SPECIES PRESENT IN EACH SECTION

1 ..... Sd, Ip, Lp, Nl, No, Po, Uv, Cd

2 ..... Sd, Pp, Ip, Ju, Tl, No, Po, Uv

3 ..... Sd, Ju, Ip, Tl, Nl, No, Bs, Pc, Po, Cd, Uv

4 ..... Ju, Sd, Ip, Pp, No, Nl, Pe, Ag, Uv, Po

5 ..... Ju, Sd, No, Nl, Pa, Pc, Ag, Cd, Ec, Nf, Po, Pe, Pb

6 ..... Sd, Ju, Lp, Pp, Tl, No, Nl, Bs, Cd, Ni, Uv, Pb, Nf, Po, Ec

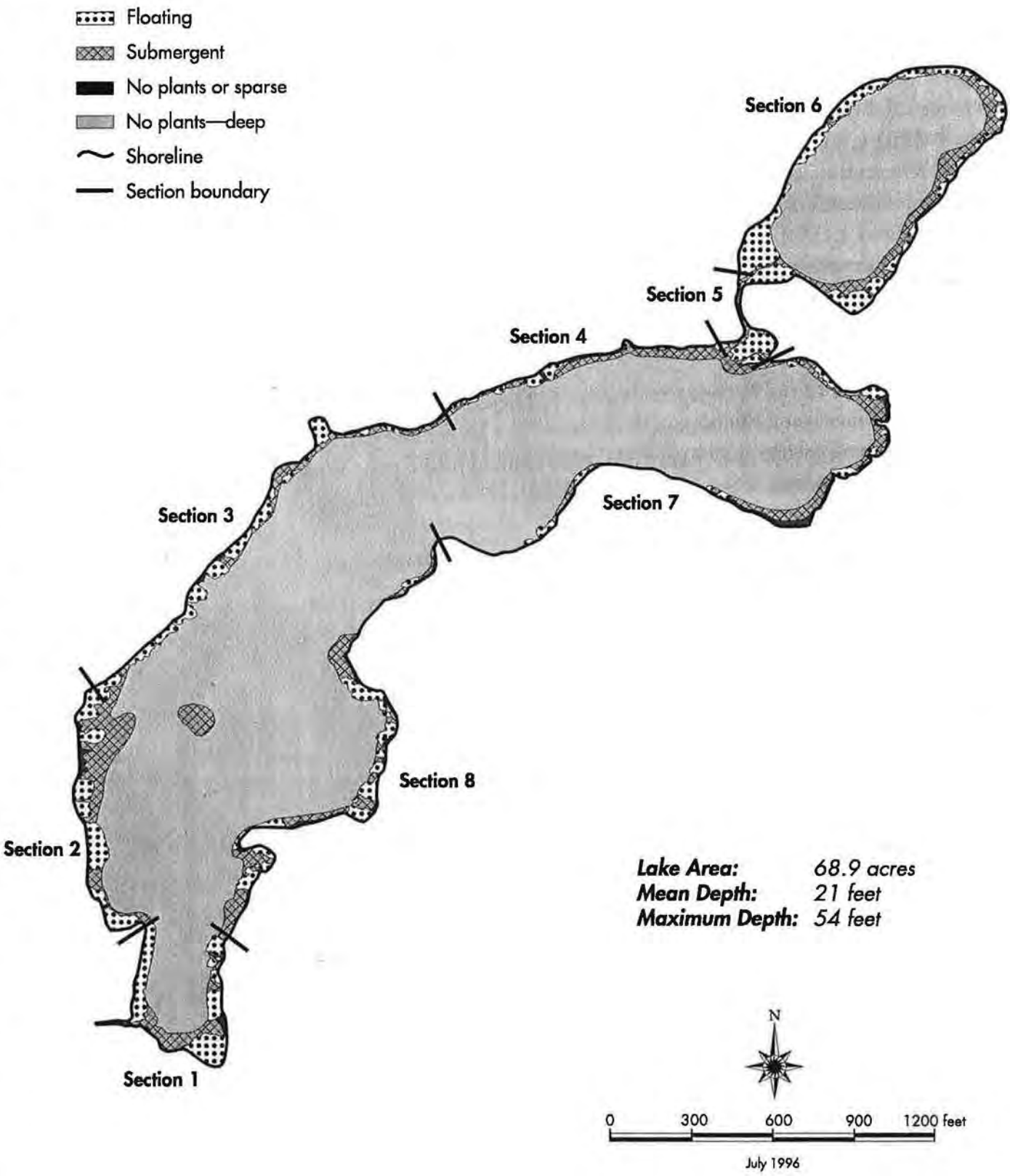
7 ..... Ju, Sd, Ip, Tl, Pp, Hs, Pm, Lp, Nl, No, Bs, Uv, Po, Ec, Ni, Pb

8 ..... Ju, Sd, Ip, Pd, Pp, Lp, Mp, Tl, No, Nl, Bs, Po, Pb, El

Additional species not noted by sections but identified from collected plant material included Sc, Fo, and My.

Beaver

Aquatic Plants Map



Beaver, continued

Beaver Lake was surveyed in 1976, 1978, 1980, and 1992 (Metro, 1976, 1978, and 1978; King County, 1993). Based on a 1976 survey, *Isoetes boanderi, Potamogeton amplifolius,* and *Potamogeton epihydrus* were the dominant species in the lake. In 1978 and 1980 surveys, coverage by both *Potamogeton* species was reduced and replaced by *Nymphaea odorata* and *Nuphar lutea. Potamogeton angustifolius* (now *Potamogeton illinoensis*) and *Potamogeton natans* were recorded during the 1992 surveys as well as a similar complement of species previously observed (King County, 1993). Based on 1995 aerial imagery, *Nymphaea odorata* and *Nuphar lutea* still remain the dominant aquatic plant species. The 1995 submergent community was slightly more diverse with 12 submergent species compared with 10-11 species observed during 1978, 1980, and 1992 surveys. *Chara sp., Myriophyllum sp., Potamogeton crispus,* and *Potamogeton zosteriformis* were new submergent species observed while *Isoetes boanderi, Potamogeton augustifolius, Potamogeton natans,* and *Potamogeton epihydrus* were not observed during the 1995 survey.

The identification of the *Potamogeton* species can be difficult. The past survey and current survey results suggest that several Potamogeton species have been observed during the past 20 years. It is possible that some species may have been misidentified in the past. Without historical herbarium specimens, confirmation of past plant identification cannot be completed.

Cottage

Cottage Lake was surveyed on July 31, 1995. The survey team was assisted by Cottage Lake resident Chuck Eberhart. Secchi depth was 3.0 meters. Sky conditions were sunny during the survey. Eighteen plant species (listed below) were identified including eight emergent types, two floating types, and eight submergent types. The floating plant coverage totaled 6.4 acres while the submergent community comprised 3.9 acres. The submergent plant percent cover was less than 25 percent through out the lake. Section 2 had moderate coverage (between 25 and 75 percent) of floating plants which were concentrated largely at the lake outlet. Emergent vegetation coverage has been impacted by shoreline development, however there are shoreline areas in Sections 2, 4, and 5 where significant shoreline vegetation remains.

Cottage Lake was previously surveyed in 1976, 1978, and 1993 (Metro 1976 and 1978; King County 1996). *Potamogeton pusillus, Elodea canadensis, Najas flexilis,* and *Nymphaea odorata* were the most common plants found in the lake based on the 1976 survey. During 1978, a decrease in the presence of Potamogeton sp. was noted while the coverage of *Nymphaea odorata* remained at about 6 acres. This historical acreage is consistent with current floating plant coverage indicating that the lilies have not significantly increased their distribution in the past twenty years and are probably limited by depth. *Chara sp.*, *Potamogeton epihydrus*, and *Brasenia schreberi* were observed in previous surveys.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Callitriche sp.	Cp	Nymphaea odorata	No
Ceratophyllum demersum	Cd	Potamogeton amplifolius	Pa
Elodea canadensis	Ec	Potamogeton pusillus	Pb
Iris pseudacorus	Ip	Potamogeton richardsonii	Pi
Juncus sp.	Ju	Potentilla palustris	Pp
Lythrum salicaria	Ls	Scirpus sp.	Sb
Najas flexilis	Nf	Spiraea douglasii	Sd
Nitella sp.	Ni	Typha latifolia	Tl
Nuphar lutea	Nl	Utricularia vulgaris	Uv

SPECIES PRESENT IN EACH SECTION

1 ..... Ip, Sd, Tl, Ls, Ju, No, Pa, Ec, Pi, Cd, Pb, Cp

2 ..... Tl, Sd, Ip, Pp, Ju, No, Nl, Uv, Pb, Nf, Ec, Ni, Pa

3 ..... Ju, Sd, Ls, Tl, Pp, Ip, No, Nl, Pa, Pb, Ec, Cd

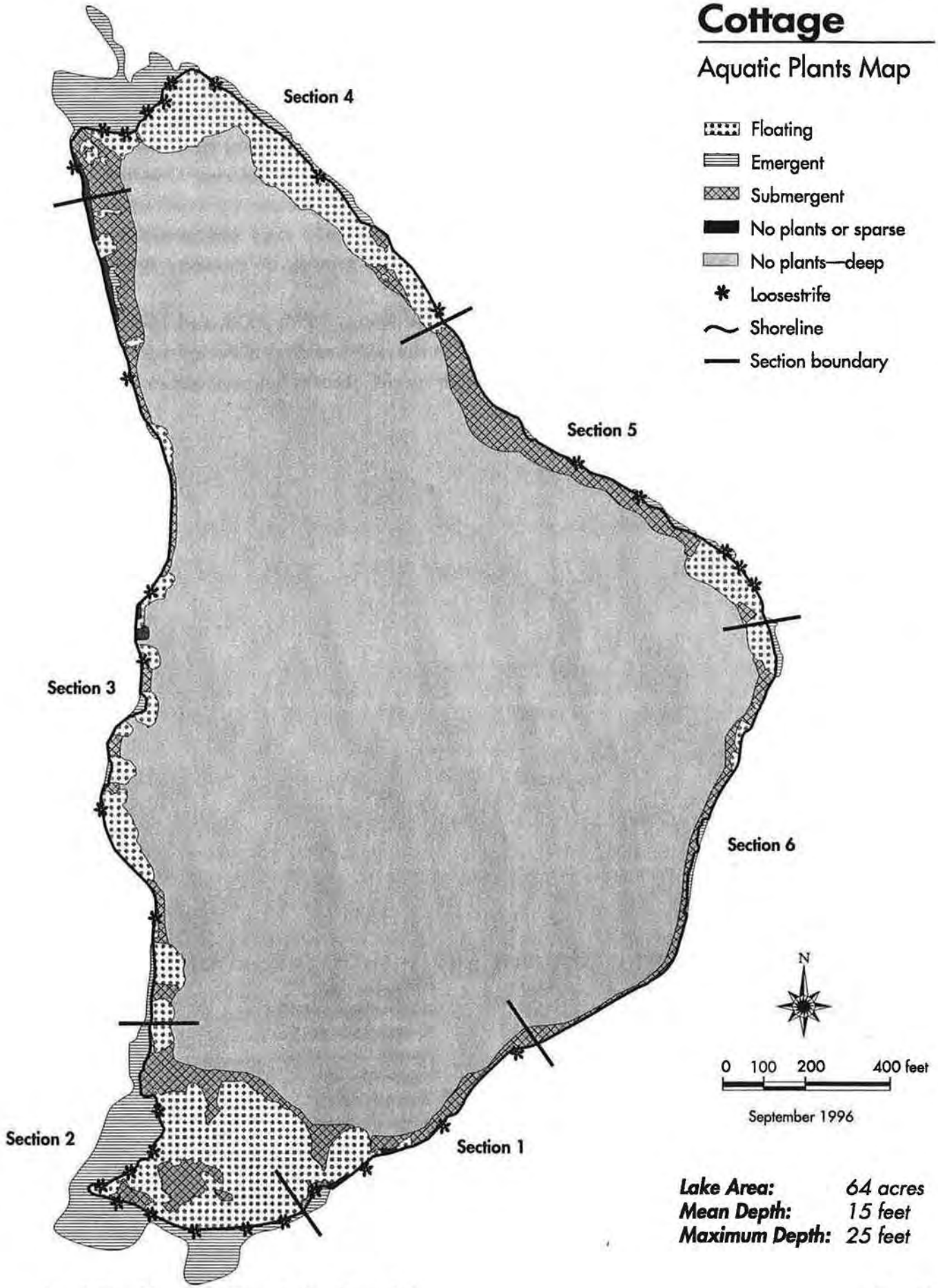
4 ..... Ip, Sd, Ls, Pp, Tl, Ju, No, Nl, Pb, Cd, Ec, Cp, Pi, Uv

5 ..... Ju, Sd, Ip, Ls, Pp, Nf, Pb, Ec, Pi

6 ..... Ip, Ju, Ls, No, Ec, Pa, Pb

Cottage

Aquatic Plants Map



Lake Area: *64 acres*
Mean Depth: *15 feet*
Maximum Depth: *25 feet*

Deep

Deep Lake was surveyed on August 28, 1995. Secchi depth was 5.2 meters. Sky conditions were sunny during the survey. Fourteen plant species (listed below) were identified including eight emergent types and six submergent types. No floating plants were observed. The submergent community coverage comprised 4.4 acres. The submergent plant percent cover was less than 25 percent through out the lake. The shoreline was generally steep and dominated by terrestrial vegetation to the lake waterline. Due to limited plant growth, no transects were taken.

The lake was surveyed in 1976, 1978, and 1980 by Metro (Metro 1976, 1978, and 1980). *Potamogeton sp.* were the most common plants found in the lake based on historical surveys. *Najas flexilis, Nitella sp., and Cabomba caroliniana* were species observed in previous surveys but were not observed during the 1995 SWM survey.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Carex sp.	Ca	Polygonum sp.	Pm
Ceratophyllum demersum	Cd	Potamogeton amplifolius	Pa
Chara sp.	Cs	Potamogeton pusillus	Pb
Elodea canadensis	Ec	Potamogeton crispus	Pc
Iris pseudacorus	Ip	Ranunculus sp.	Rs
Juncus sp.	Ju	Sparganium sp.	Sf
Ludwigia palustris	Lp	Spiraea douglasii	Sd

SPECIES PRESENT IN EACH SECTION

1 ..... Pa, Ec, Pb

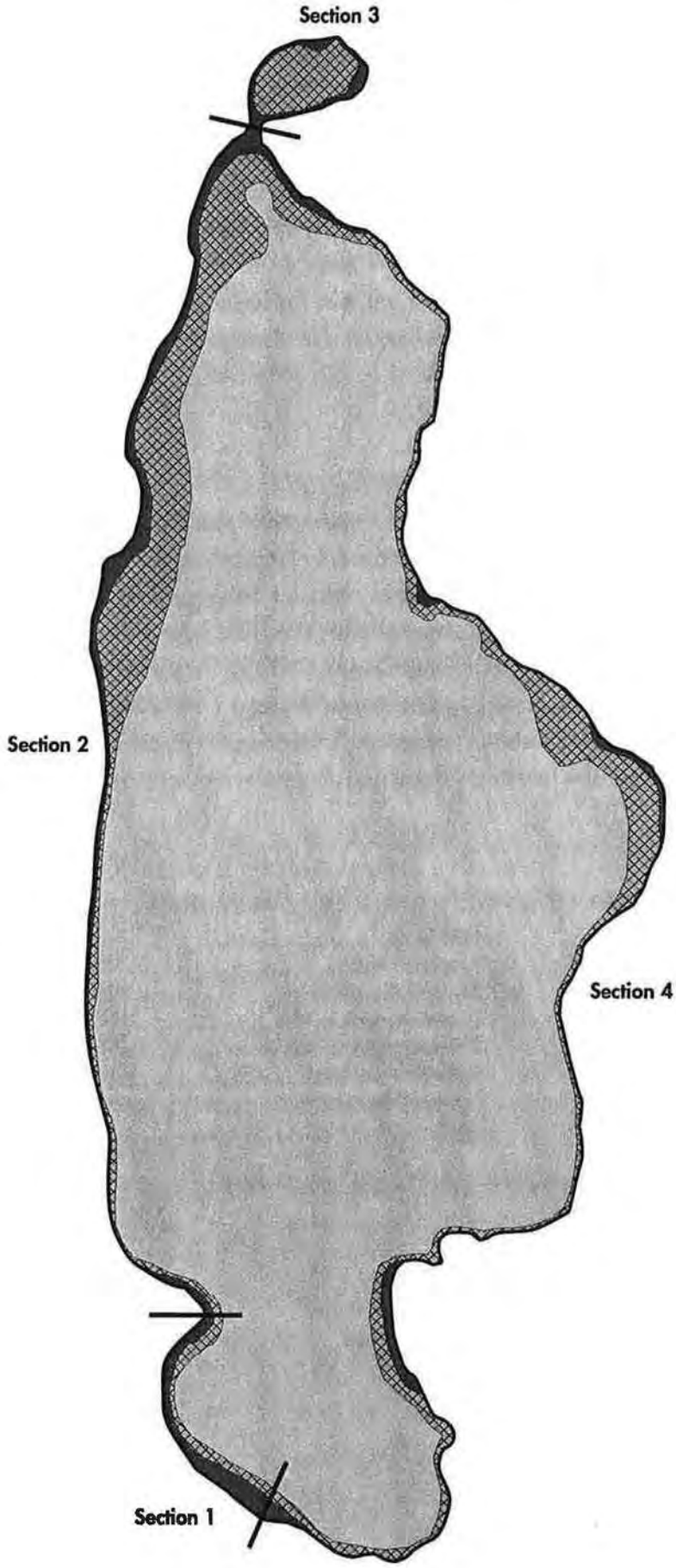
2 ..... Ca, Sd, Pa, Ec, Pb

3 ..... Lp, Pm, Ca, Pa, Ec

4 ..... Ca Lp, Ju, Cs, Pa, Ec, Pc, Cd, Pb

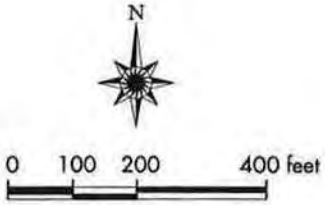
Deep

Aquatic Plants Map



- Floating
- Emergent
- Submergent
- No plants or sparse
- No plants—deep
- Shoreline
- Section boundary

Lake Area: *37.5 acres*
Mean Depth: *33 feet*
Maximum Depth: *74 feet*



Desire

Lake Desire was surveyed on July 24, 1995. The survey team was assisted by Lake Desire resident Ed Merrill. Secchi depth was 2.0 meters. Sky conditions were overcast. Sixteen plant species (listed below) were identified including seven emergent types, three floating types, and six submergent types. The floating plant coverage totaled 3.0 acres while the submergent community comprised 13.0 acres. In most sections, percent cover was typically less than 25 percent. The shoreline is heavily infested with *Lythrum salicaria*. The remaining emergent vegetation coverage was fairly limited by shoreline development or the presence of terrestrial vegetation.

During the 1976 through 1980 aquatic plant surveys (Metro, 1976; 1977; 1978; 1979; and 1980) no single dominant species was noted. *Elodea canadensis, Potamogeton pusillus, Brasenia schreberi, Nymphaea odorata*, and *Nuphar lutea* were commonly found throughout the lake during these surveys. *Myriophyllum spicatum* was first observed in the lake during 1979 along the southeast shoreline and can currently be found in several areas of the lake. The lake was also surveyed during 1994 and reflected a similar species list (King County, 1995). In previous surveys, *Chara sp., Fontinalis, Potamogeton natans, Potamogeton epihydrus,* and *Utricularia vulgaris* were observed. Both *Potamogeton epihydrus* and *Potamogeton zosteriformis* closely resemble one another. It is possible that historical surveys may have misidentified *Potamogeton zosteriformis* as *Potamogeton epihydrus*.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Brasenia schreberi	Bs	Nitella sp.	Ni
Ceratophyllum demersum	Cd	Nuphar lutea	Nl
Eleocharis sp.	El	Nymphaea odorata	No
Elodea canadensis	Ec	Potamogeton pusillus	Pb
Iris pseudacorus	Ip	Potamogeton zosteriformis	Pz
Lythrum salicaria	Ls	Potentilla palustris	Pp
Myriophyllum spicatum	Ms	Spiraea douglasii	Sd
Najas flexilis	Nf	Typha latifolia	Tl

SPECIES PRESENT IN EACH SECTION

1 ..... Tl, Ls, Ip, Sd, Ls, Pp, No, Nl, Ms, Ec, Pb, Cd, Ni

2 ..... Ip, Ls, Tl, Pp, El, Bs, Nl, No, Ec, Ms, Nf, Pb, Cd

3 ..... Ls, Tl, Sd, Ip, Pp, El, Ip, No, Bs, Nl, Ec, Ms, Pb

4 ..... Ls, Tl, Ip, Sd, El, Pp, No, Nl, Bs, Ec, Pb, Pz

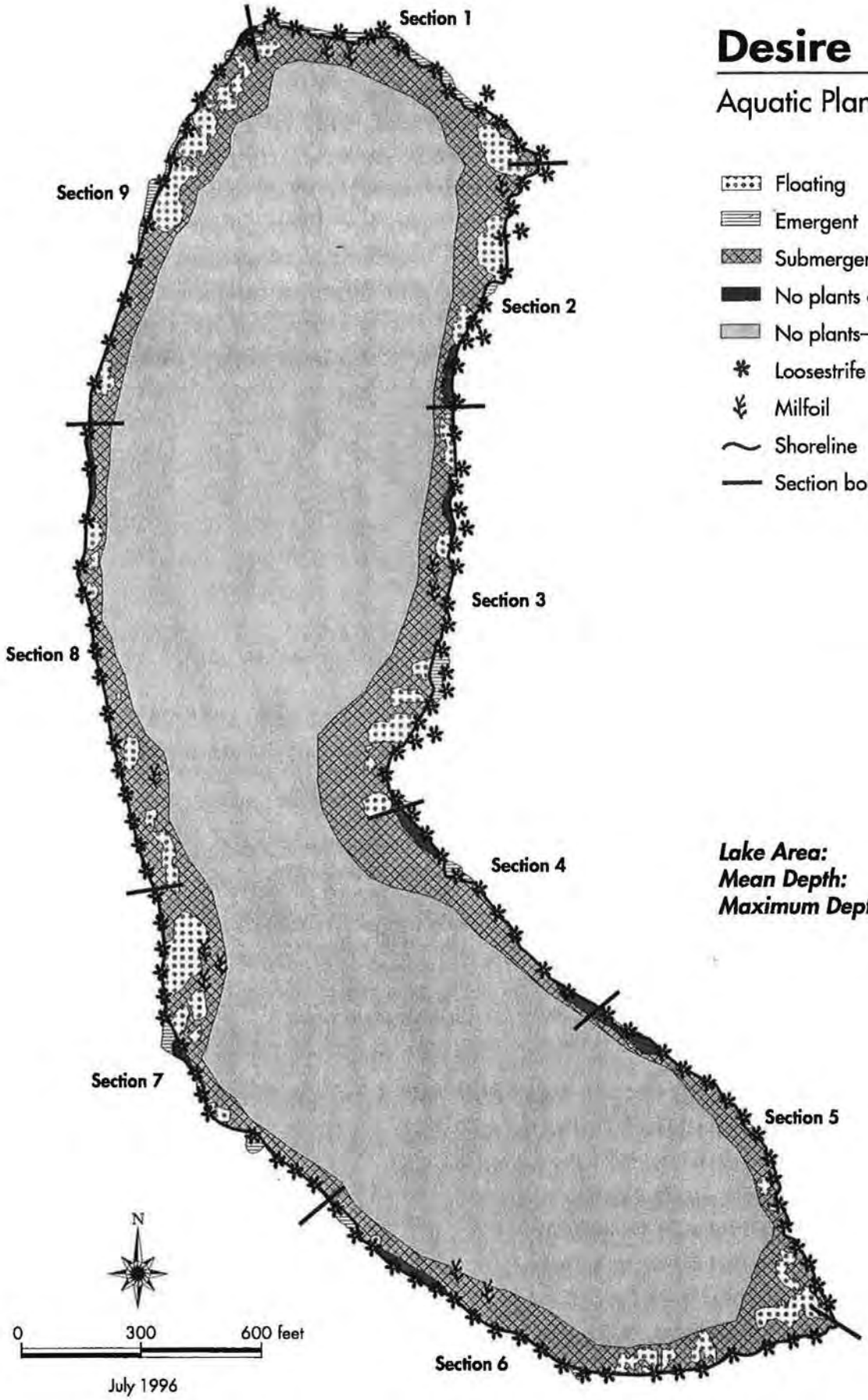
5 ..... Tl, Ls, Nl, No, Bs, Ni, Ec, Cd, Nf, Pz

6 ..... Tl, Ls, Pp, Bs, No, Ec, Pb, Cd, Ms

7 ..... Ls, Tl, El, Ip, Pp, Pb, No, Nl, Cd, Ec, Pz, Ms

8 ..... Tl, Ls, Bs, No, Nl, Ec, Ni, Pb, Ms

9 ..... Tl, Ls, Ip, Pp, El, No Nl, Ec, Cd



Desire

Aquatic Plants Map

- Floating
- Emergent
- Submergent
- No plants or sparse
- No plants—deep
- Loosestrife
- Milfoil
- Shoreline
- Section boundary

Lake Area: *57.2 acres*
Mean Depth: *13 feet*
Maximum Depth: *21 feet*

Dolloff

Lake Dolloff was surveyed on July 28, 1994. Secchi depth was 1.8 meters. The water was highly colored by organic acids. The weather during the survey was initially cloudy and eventually became sunny. Twenty-five plant species (listed below) were identified including 11 emergent types, two floating types, and 12 submergent types. The floating plant coverage totaled 3.6 acres while the submergent community comprised 5.8 acres. In most sections, percent cover was typically between 25 and 75 percent for floating and submergent communities. The presence of submergent plant growth generally diminished after two meters. Emergent vegetation also ranged from 25 to 75 percent cover along the shoreline with a large wetland located on the northwest end of the lake.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Carex sp.	Ca	Nitella sp.	Ni
Ceratophyllum demersum	Cd	Nuphar lutea	Nl
Chara sp.	Cs	Nymphaea odorata	No
Eleocharis sp.	El	Polygonum sp.	Pm
Elodea canadensis	Ec	Potamogeton amplifolius	Pa
Fontinalis sp.	Fo	Potamogeton pusillus	Pb
Iris pseudacorus	Ip	Potamogeton epihydrus	Pe
Isoetes sp.	Is	Potamogeton robbinsii	Po
Juncus sp.	Ju	Potentilla palustris	Pp
Ludwigia palustris	Lp	Spiraea douglasii	Sd
Lythrum salicaria	Ls	Typha latifolia	Tl
Myriophyllum sp.	My	Utricularia vulgaris	Uv
Myriophyllum spicatum	Ms		

SPECIES PRESENT IN EACH SECTION

1 ..... Sd, Ju, Pp, Ip, Ls, No, Nl, Pa, Pe, Fo, Ec, Cd, Cs, Is

2 ..... Sd, Ju, Tl, Pp, Ls, No, Nl, Pa, Pe, Is, My, Cd, Pm, Ca

3 ..... Ip, Ju, Sd, Pp, Ca, Po, Nl, Pa, My, Ec, Pm

4 ..... Sd, Ju, Ip, Nl, Pa, Fo, Ec, Is, Pb, My

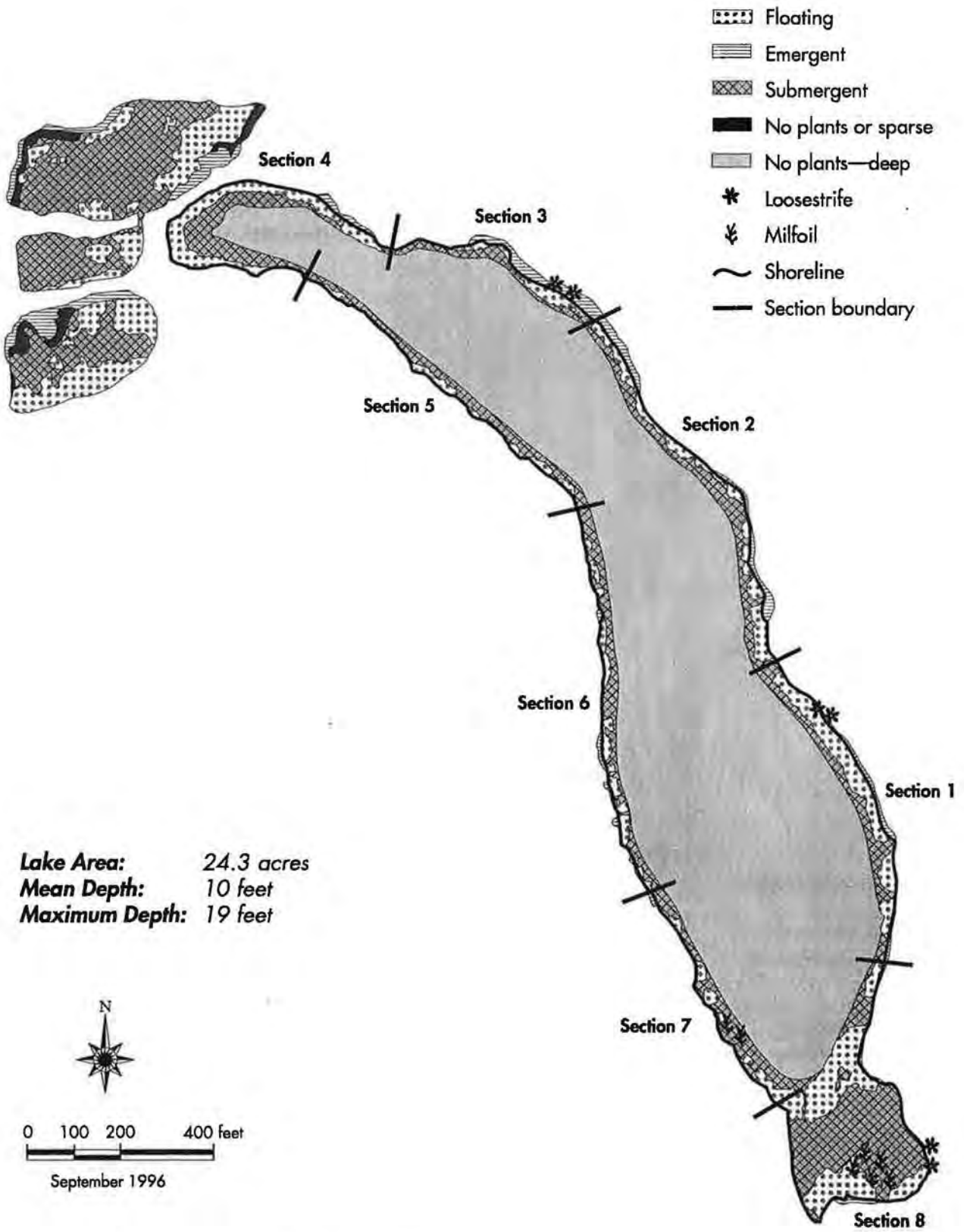
6 ..... Sd, Ip, Ju, Pp, Nl, No, Pa, Is, Pe, Ec, Lp

7 ..... Sd, Ip, Pp, Nl, No, Pa, Fo, Ec, Cs

8 ..... Ju, Pp, Tl, Sd, Nl, No, Pe, Fo, Ms, Pb, My, Ec, Cs, Ni

Dolloff

Aquatic Plants Map



Fivemile

Fivemile Lake was surveyed on August 10, 1994. Secchi depth was 1.4 meters. The survey team was assisted by Fivemile Lake resident Cindy Hunsaker. The weather during the survey was sunny.

Fifteen plant species (listed below) were identified including six emergent types, three floating types, and six submergent types. The floating plant coverage totaled 8.8 acres while the submergent community comprised 4.0 acres. Percent cover was less than 25 percent for floating and submergent communities throughout the lake. Submergent plant depth generally diminished after two meters. Emergent vegetation was also less than 25 percent with most of the shoreline developed for residential uses.

SPECIES PRESENT AND THEIR ABBREVIATIONS

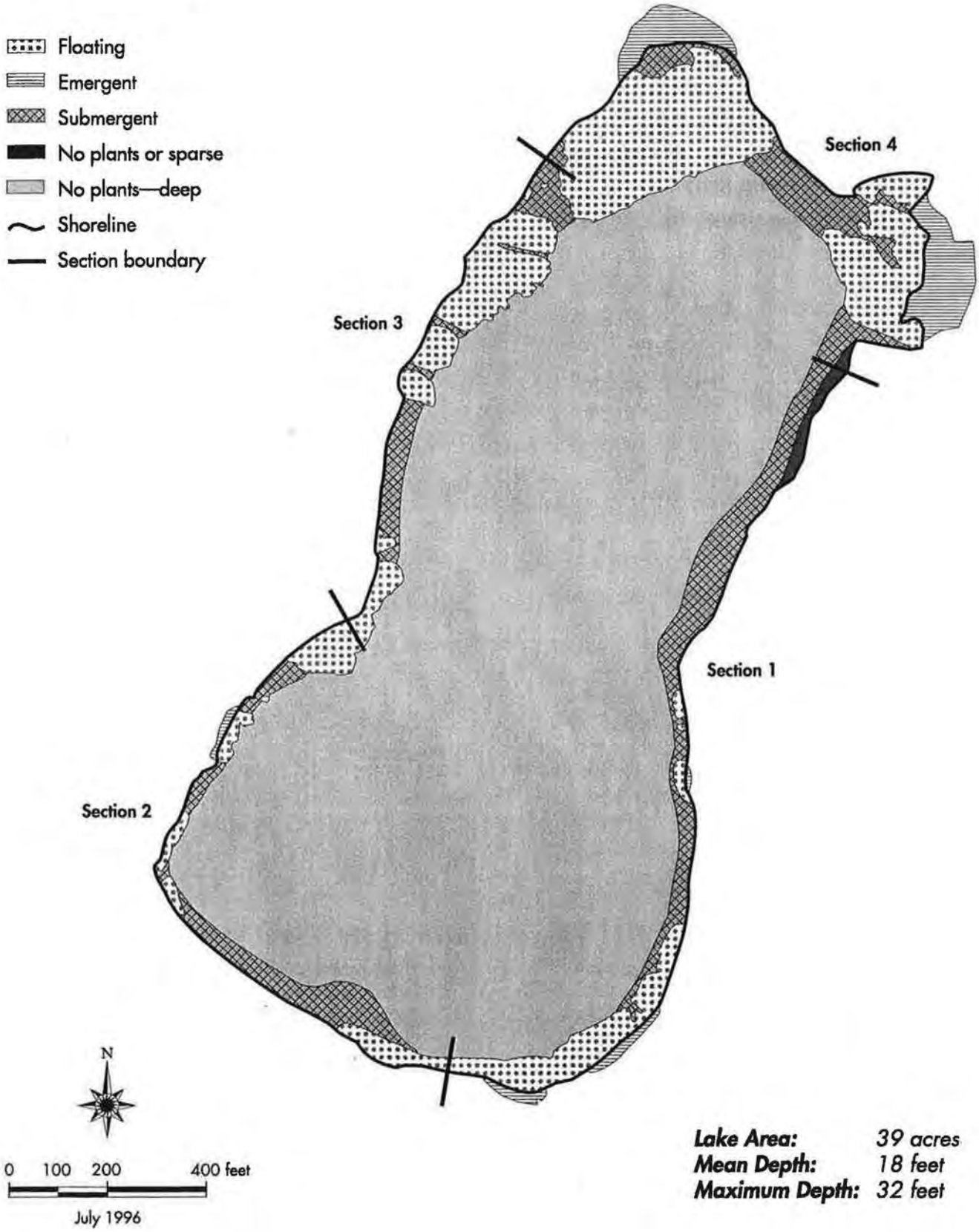
Brasenia schreberi	Bs	Nymphaea odorata	No
Chara sp.	Cs	Potamogeton pusillus	Pb
Elodea canadensis	Ec	Potamogeton crispus	Pc
Iris pseudacorus	Ip	Potentilla palustris	Pp
Juncus sp.	Ju	Scirpus sp.	Sb
Ludwigia palustris	Lp	Spiraea douglasii	Sd
Najas flexilis	Nf	Utricularia sp.	Us
Nuphar lutea	Nl		

SPECIES PRESENT IN EACH SECTION

1 ..... Sd, Ip, Ju, No, Nl, Bs, Lp, Us, Cs	3 ..... Sd, Ip, No, Ec, Lp, Pe, Nf
2 ..... Ip, Sd, No, Bs, Us, Lp, Pe	4 ..... Sd, Ju, Ip, Pp, No, Nl

Fivemile

Aquatic Plants Map



Lake Area: *39 acres*
Mean Depth: *18 feet*
Maximum Depth: *32 feet*

Francis

Francis Lake was surveyed on August 14, 1995. Secchi depth was 1.0 meters. The survey team was assisted by Francis Lake resident Brian Moriety. The weather during the survey was overcast. Twelve plant species (listed below) were identified including four emergent types, two floating types, and six submergent types. The floating plant coverage totaled 5.7 acres while the submergent community comprised 6.4 acres. Percent cover was greater than 75 percent for floating plants and less than 25 percent for submergent plants throughout the lake. The thinly distributed submergent plant community generally diminished after 2.5 meters. Emergent vegetation cover was greater than 75 percent with most of the shoreline undeveloped for residential uses.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Brasenia schreberi	Bs	Potamogeton pusillus	Pb
Chara sp.	Cs	Potamogeton zosteriformis	Pz
Juncus sp.	Ju	Potentilla palustris	Pp
Nitella sp.	Ni	Spiraea douglasii	Sd
Nuphar lutea	Nl	Typha latifolia	Tl
Potamogeton amplifolius	Pa	Utricularia vulgaris	Uv

SPECIES PRESENT IN EACH SECTION

1 ..... Tl, Sd, Ju, Pp, Nl, Bs, Pa, Uv, Pz, Cs

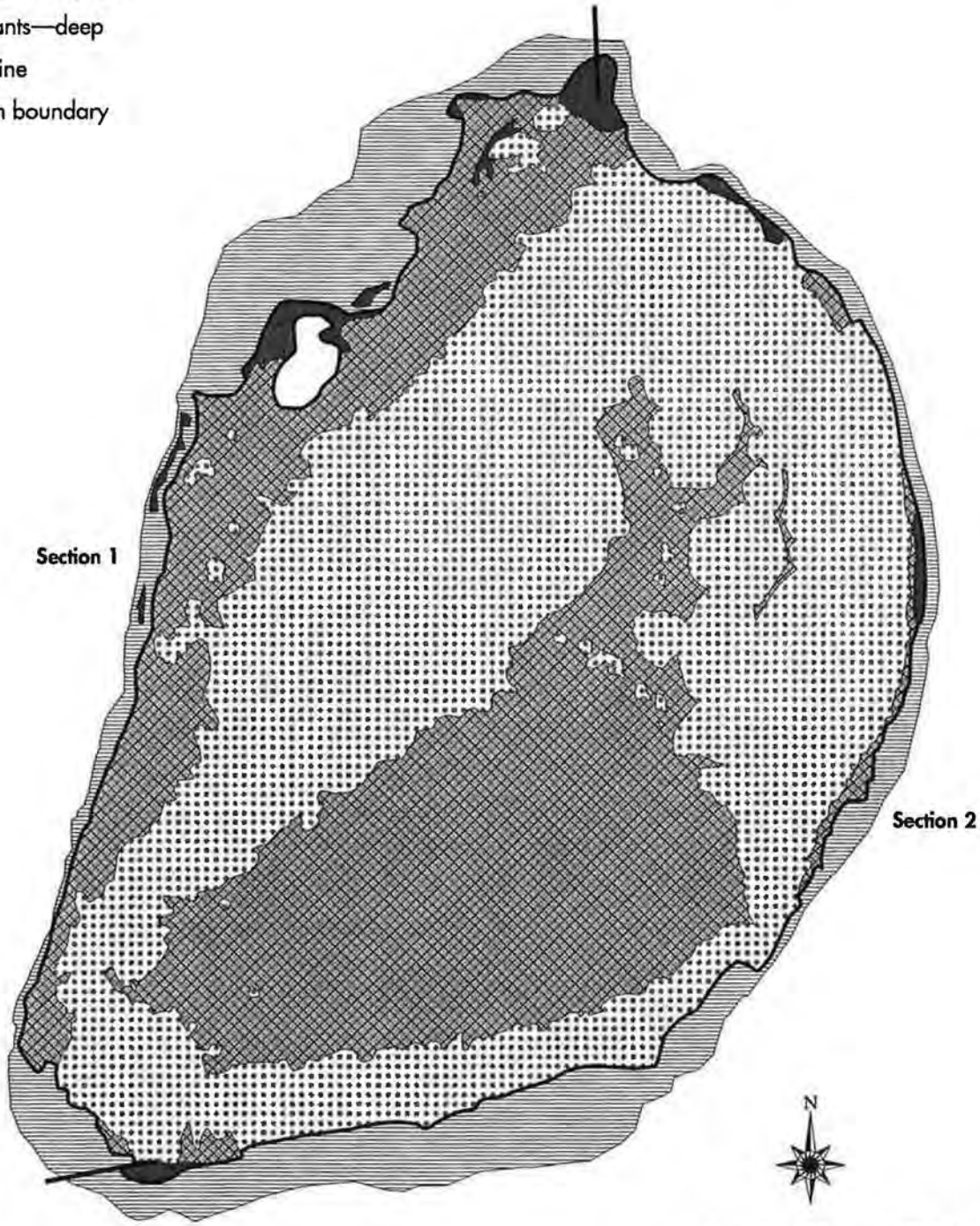
2 ..... Tl, Sd, Ju, Pp, Nl, Bs, Uv, Pz, Cs, Ni

Francis

Aquatic Plants Map

- Floating
- Emergent
- Submergent
- No plants or sparse
- No plants—deep
- Shoreline
- Section boundary

Lake Area: *15.4 acres*
Mean Depth: *4 feet*
Maximum Depth: *9 feet*



September 1996

Geneva

Lake Geneva was surveyed on August 9, 1994. Secchi depth was 4.2 meters with good water clarity. The survey team was assisted by Lake Geneva resident Delores Pounds. The weather during the survey was partly sunny. Seventeen plant species (listed below) were identified including eight emergent types, two floating types, and seven submergent types. The floating plant coverage totaled 3.4 acres while the submergent community comprised 6.8 acres. Percent cover was generally less than 25 percent for floating and submergent communities with only several sections having between 25 and 75 percent. Submergent plant coverage generally diminished after three meters. Emergent vegetation was also less than 25 percent with most of the shoreline developed for residential uses.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Ceratophyllum demersum	Cd	Nymphaea odorata	No
Chara sp.	Cs	Polygonum sp.	Pm
Elodea canadensis	Ec	Potamogeton amplifolius	Pa
Iris pseudacorus	Ip	Potamogeton pusillus	Pb
Juncus sp.	Ju	Potentilla palustris	Pp
Ludwigia palustris	Lp	Spiraea douglasii	Sd
Najas flexilis	Nf	Typha latifolia	Tl
Nitella sp.	Ni	Utricularia vulgaris.	Uv
Nuphar lutea	Nl		

SPECIES PRESENT IN EACH SECTION

1 ..... Sd, Ip, Pp, Tl, No, Pa, Pb, Ec, Uv, Cd, Nf

2 ..... Ip, Tl, Sd, Pp, Pa

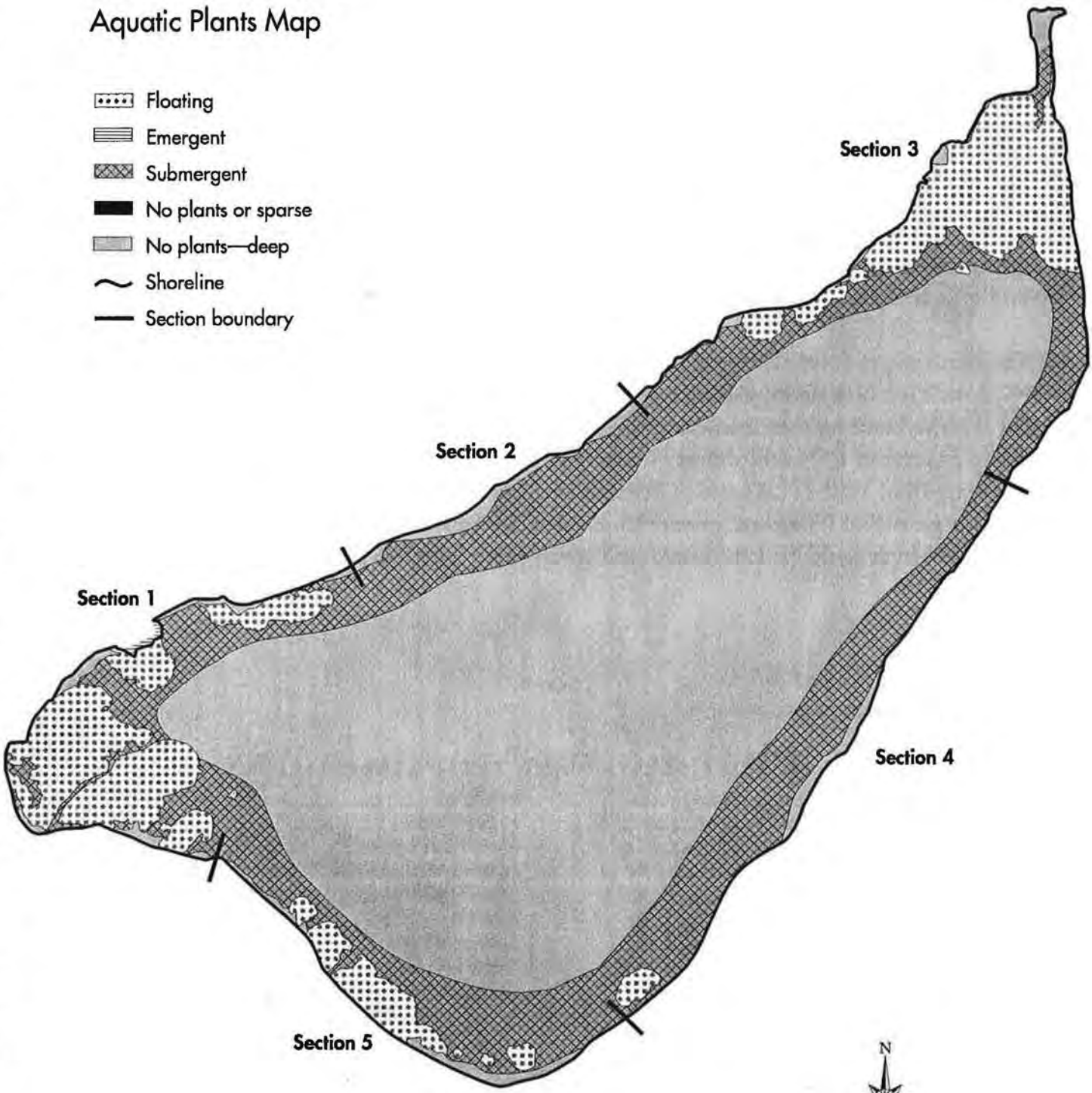
3 ..... Tl, Ip, Sd, Pp, Ju, No, Nl, Uv, Ec, Pa, Ni, Lp, Cs

4 ..... Ip, Pp, Ju, Pa

5 ..... Sd, Ju, No, Pa, Pb, Ec, Ni

Geneva

Aquatic Plants Map



July 1996

Lake Area: *27.9 acres*
Mean Depth: *19 feet*
Maximum Depth: *46 feet*

Kathleen

Lake Kathleen was surveyed on August 17, 1995. Secchi depth was 1.8 meters. Sky conditions were cloudy and raining. Eighteen plant species (listed below) were identified including eight emergent types, three floating types, and seven submergent types. The floating plant coverage totaled 11.4 acres while the submergent community comprised 8.6 acres. In most sections, percent cover was typically between 25 and 75 percent. Submergent vegetation could be found to a depth of two meters. Emergent vegetation coverage was fairly limited by shoreline development. Wetland vegetation dominates the northern end of the lake while *Lythrum salicaria* is beginning to become established around the shoreline.

Lake Kathleen was previously surveyed in 1976 and 1978 (Metro 1976 and 1978). *Brasenia schreberi, Nitella sp., Nymphaea odorata*, and *Potamogeton sp.*, were the most common plants found in the lake based on these two surveys. The coverage of *Brasenia schreberi* and *Nymphaea odorata* was 25 acres in 1976 and almost 30 acres in 1978. This areal coverage is greater than what was mapped in 1995 (11.4 acres). Lake residents have used herbicides in the past 10 years to control the growth of *Nymphaea odorata* (Bob Allen, Personnel Communication, July 16, 1996) which could explain the reduced coverage seen in 1995 compared with 1976 and 1978.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Brasenia schreberi	Bs	Nitella sp.	Ni
Ceratophyllum demersum	Cd	Nuphar lutea	Nl
Chara sp.	Cs	Nymphaea odorata	No
Elodea canadensis	Ec	Potamogeton amplifolius	Pa
Iris pseudacorus	Ip	Potamogeton pusillus	Pb
Juncus sp.	Ju	Potentilla palustris	Pp
Ludwigia palustris	Lp	Spiraea douglasii	Sd
Lythrum salicaria	Ls	Typha latifolia	Tl
Najas flexilis	Nf	Utricularia vulgaris	Uv

SPECIES PRESENT IN EACH SECTION

1 ..... Ju, Ls, Tl, Sd, Pp, Ip, Bs, Nl, No, Ec, Ni, Cd, Pb, Uv

2 ..... Sd, Ju, Tl, Ls, Pp, Ip, No, Nl, Bs, Uv, Pb, Ni

3 ..... Ls, Ip, Ju, Sd, Pp, Tl, No, Bs, Nl, Pb, Uv, Ec, Ni, Cd, Pa

4 ..... Sd, Tl, Ip, Ls, Pp, Ju, No, Bs, Nl, Ec, Uv, Ni, Pb

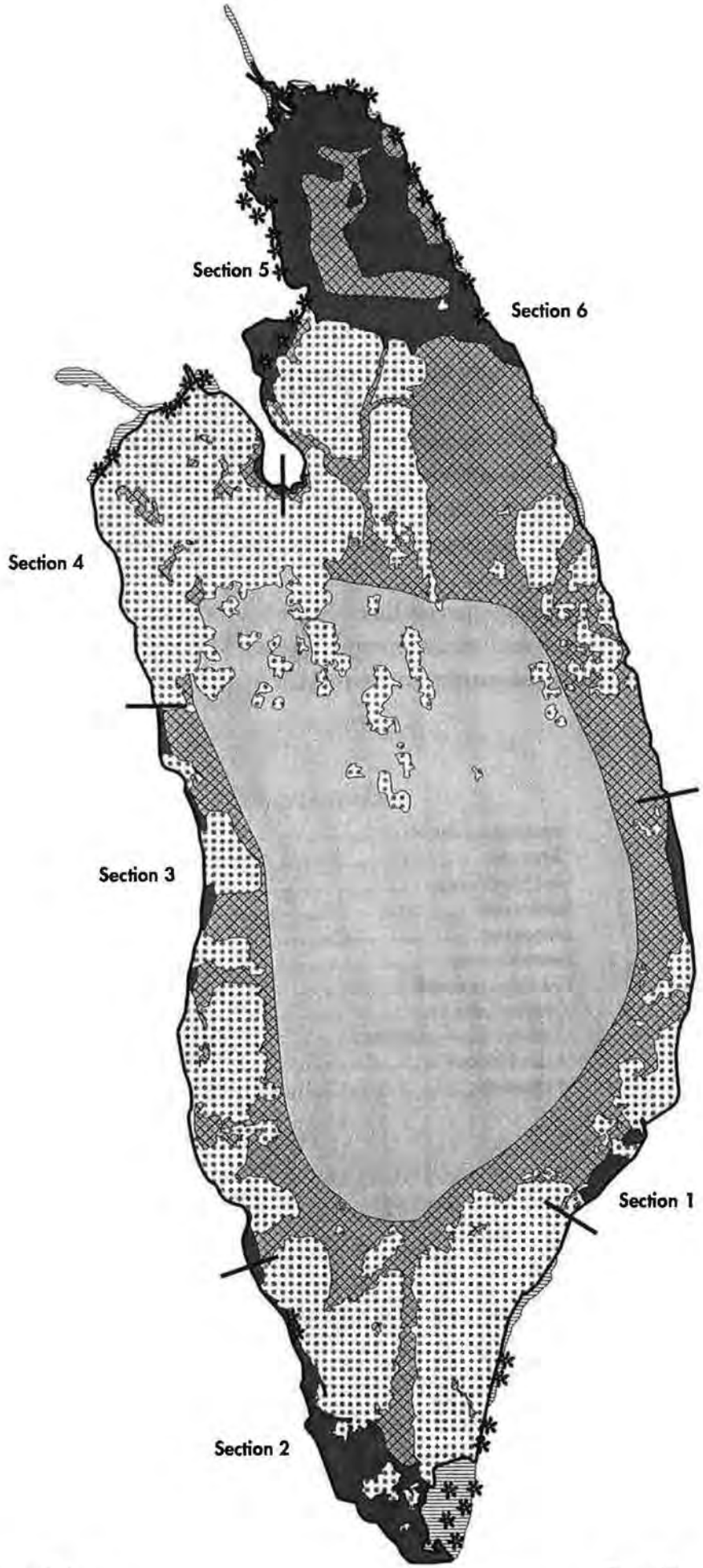
5 ..... Sd, Pp, Ju, Ls, Tl, Ip, No, Bs, Pa, Ec, Pb, Nf, Uv

6 ..... Ls, Pp, Ip, Ju, Sd, No, Bs, Nl, Uv, Ec, Pb

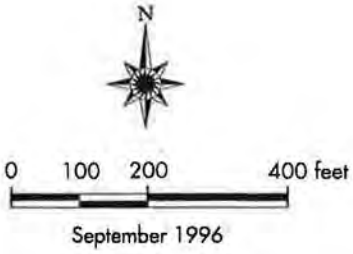
Kathleen

Aquatic Plants Map

- Floating
- Emergent
- Submergent
- No plants or sparse
- No plants—deep
- Loosestrife
- Shoreline
- Section boundary



Lake Area: *37.7 acres*
Mean Depth: *7 feet*
Maximum Depth: *22 feet*



September 1996

Killarney

Lake Killarney was surveyed on August 22, 1994 and July 19, 1995. Secchi depth was 4.2 meters with good water clarity. The survey team was assisted by Lake Killarney resident Gerri Baldwin during the 1995 survey. The weather was cloudy during the 1994 survey and sunny during 1995.

An integrated aquatic plant management plan (IAPMP) is currently being developed to address ongoing aquatic plant management at Lake Killarney. The lake is very shallow and has the potential for 100 percent coverage by aquatic plants. Historically, herbicides have been used to maintain open water areas. The residents are now looking to develop a more holistic approach to the management of their lake and are anticipating a completed IAPMP this fall. Killarney was surveyed the second year as part of the integrated aquatic plant management planning effort.

Twenty-two plant species (listed below) were identified including eight emergent types, four floating types, and ten submergent types. The floating plant coverage totaled 2.1 acres while the submergent community comprised 23.8 acres. Percent cover was variable throughout the lake,

SPECIES PRESENT AND THEIR ABBREVIATIONS

Brasenia schreberi	Bs	Nuphar lutea	Nl
Chara sp.	Cs	Nymphaea odorata	No
Iris pseudacorus	Ip	Potamogeton amplifolius	Pa
Isoetes sp.	Is	Potamogeton pusillus	Pb
Juncus sp.	Ju	Potamogeton epihydrus	Pe
Lemma minor	Lm	Potamogeton natans	Pn
Ludwigia palustris	Lp	Potentilla palustris	Pp
Lythrum salicaria	Ls	Sparganium sp.	Sf
Myriophyllum spicatum	Ms	Spiraea douglasii	Sd
Najas flexilis	Nf	Typha latifolia	Tl
Nitella sp.	Ni	Utricularia vulgaris	Uv

SPECIES PRESENT IN EACH SECTION

1 ..... Tl, Sd, Ju, Cs, El, Bs, Uv

2 ..... Sd, Ju, Pp, Nl, Bs, No, Cs, Uv, Pa, Pb, Pe, Nf

3 ..... Sd, Ip, Pp, Ju, Nl, Uv, Bs, Cs, No, Nf

4 ..... Sd, Pp, Ip, Nl, Bs, Nf

5 ..... Sd, Nf

6 ..... Ip, Sd, Pa, Nf

7 ..... Ip, Tl, Sd, Pp, Ju, Nf, Cs, Pa

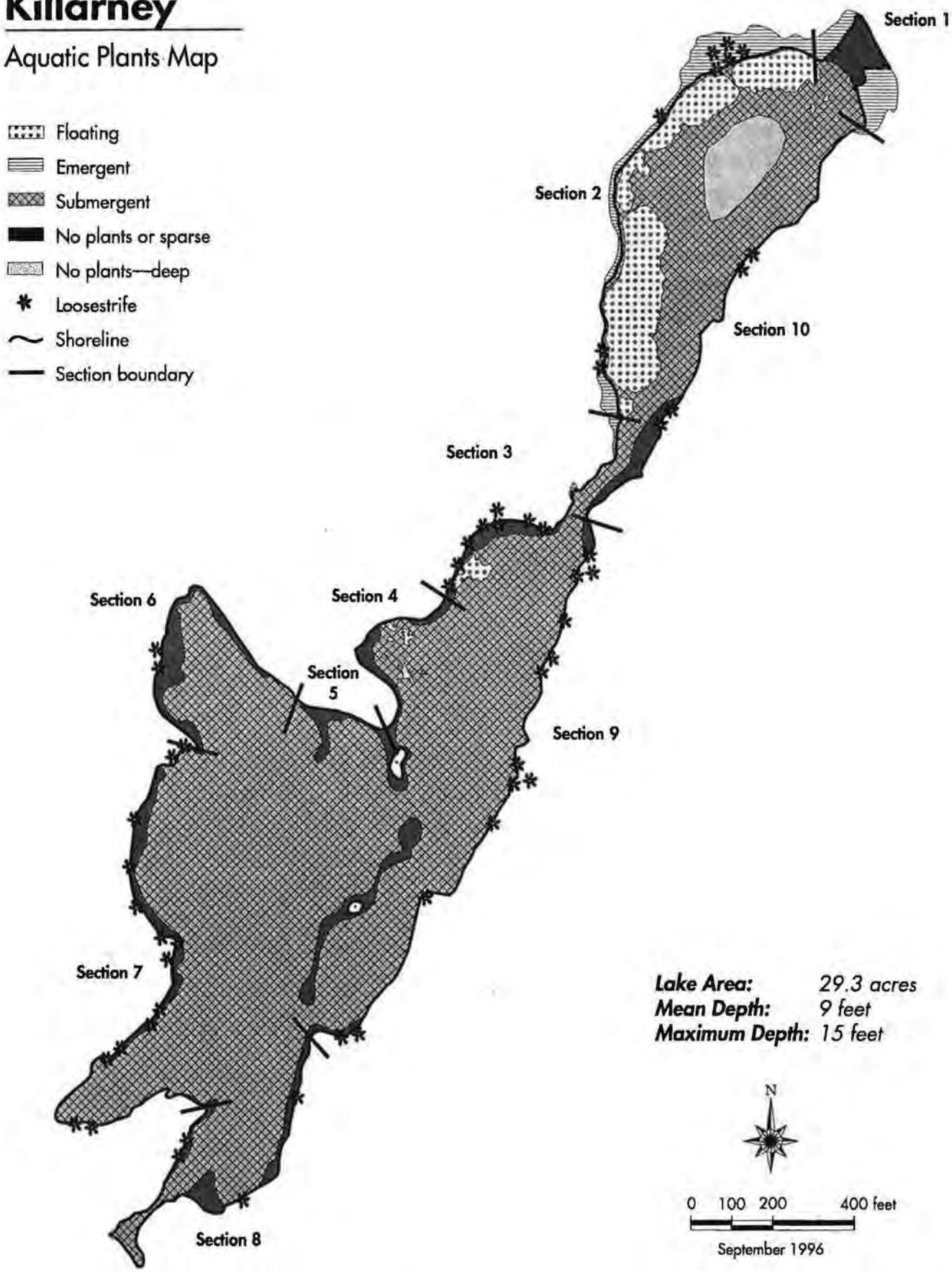
8 ..... Ju, Pp, Tl, Ip, Sd, Sf, Uv, Nf, Cs

9 ..... Sd, Ip, Ju, Pp, Nf

10 ..... Sd, Ip, Ju, Tl, Nl, Bs, Cs, Uv, Pp, Pa, Pb

Killarney

Aquatic Plants Map



ranging from light to medium to heavy coverage. Submergent plants generally diminished after three meters. Although a fairly diverse species list was documented in the lake, the submergent plant community was dominated by macrophytic algal species (*Chara sp.* and *Nitella sp*) during the 1995 survey. *Lythrum salicaria* was found throughout the shoreline areas of the lake during the 1994 survey. During 1995 and 1996, the Lake Killarney Improvement Association (LKIA) in conjunction with the SWM Division conducted *Lythrum salicaria* pulling events which have resulted in significant removal of the plant. A single *Myriophyllum spicatum* plant was found during 1995. The LKIA will continue to monitor the lake for both plants and continue to remove them by hand to prevent further spread. Several other species were noted during the 1995 survey which were not observed during 1994 which included *Isoetes sp., Lemma minor, Myriophyllum spicatum, Najas flexilis, Potamogeton epihydrus*, and *Potamogeton natans*. Their presence may have been the result of the continuing recovery of the plant community from previous herbicide applications.

Langlois

Langlois Lake was surveyed on August 1, 1995. Secchi depth was 5.2 meters. The water was very clear and the weather during the survey was sunny. Ten plant species (listed below) were identified including seven emergent types, one floating type, and two submergent types. The floating plant coverage totaled 0.2 acres while the submergent community was essentially absent. In all sections, percent cover was less than 25 percent for floating and submergent communities. Submergent plants were very limited and the floating community was limited to a few sparse patches of *Brasenia schreberi.* Emergent vegetation was also very limited. Nearly the entire shoreline was characterized by terrestrial vegetation growing on the adjacent steep slopes. Limited residential development has occurred on the lake shoreline.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Brasenia schreberi	Bs	Najas flexilis	Nf
Dulichium arundinaceum	Da	Potamogeton epihydrus	Pe
Iris pseudacorus	Ip	Potentilla palustris	Pp
Ledum groenlandicum	Lg	Spiraea douglasii	Sd
Ludwigia palustris	Lp	Typha latifolia	Tl

SPECIES PRESENT IN EACH SECTION

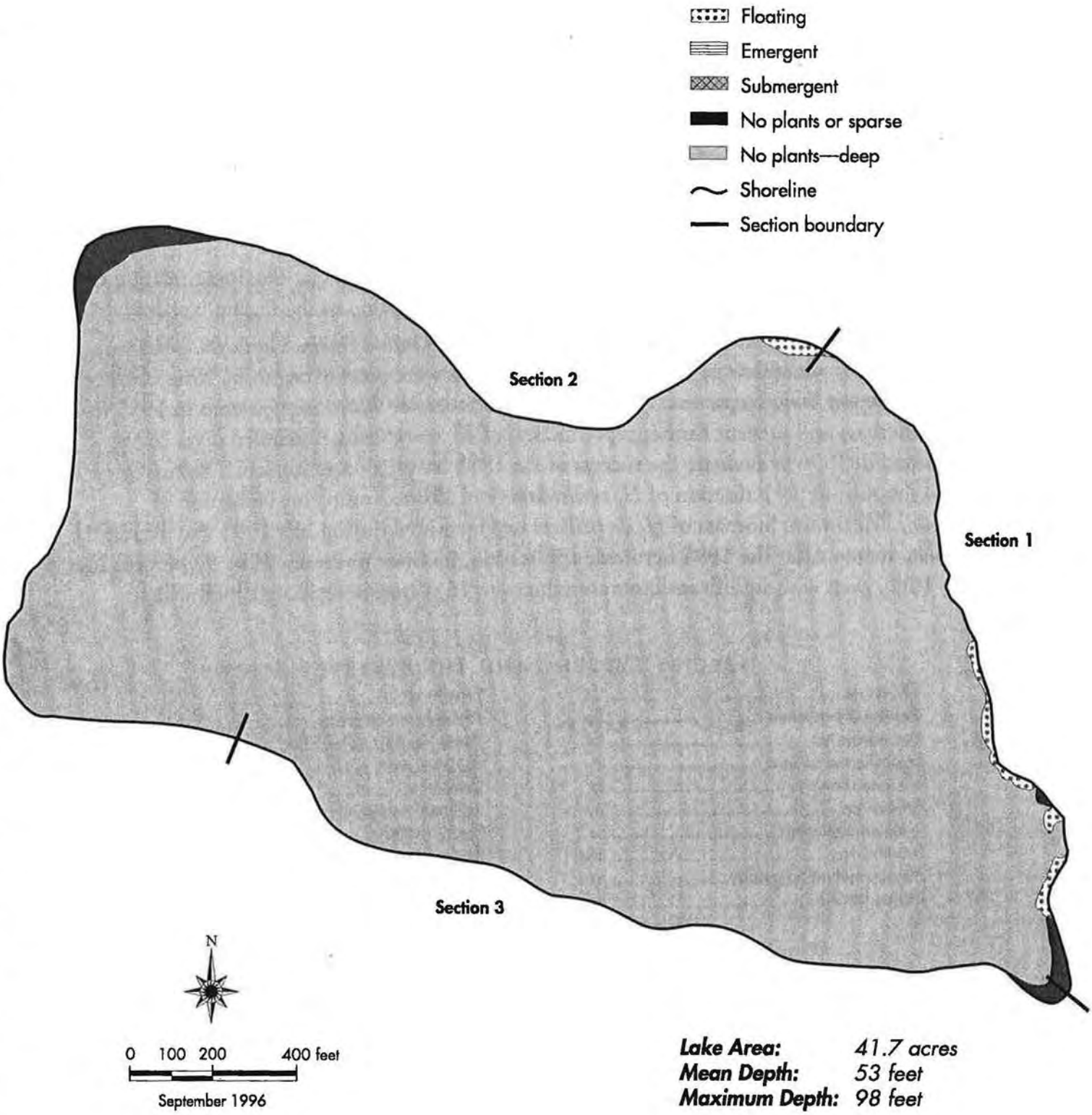
1 ..... Ip, Pp, Sd, Lp, Da, Tl, Lg, Bs, Nf, Pe

2 ..... Sd, Ip, Pp, Lp, Da, Lg, Bs

3 ..... Tl, Ip, Pp, Bs

Langlois

Aquatic Plants Map



Lake Area: *41.7 acres*
Mean Depth: *53 feet*
Maximum Depth: *98 feet*

Lucerne/Pipe

Lake Lucerne and Pipe Lake were surveyed on August 23 and 24, 1994. Secchi depth was 5.2 meters in Pipe Lake and 6.1 meters in Lake Lucerne. Sky conditions were cloudy. Nineteen plant species (listed below) were identified including nine emergent types, one floating types, and nine submergent types. The floating plant coverage totaled 10.4 acres (Lucerne 2.4 acres and Pipe 8.0 acres) while the submergent community comprised 9.3 acres (Lucerne 4.1 acres and Pipe 8.0 acres). In sections 1, 3, 4, and 6, emergent, floating, and submergent plant coverage was typically less than 25 percent throughout the section. The submergent vegetation was between 25 and 75 percent in sections 1 and 5. *Myriophyllum spicatum* was particularly abundant in sections 4 and 5.

Hydrilla verticillata was found throughout the lake during the 1994 survey. The identification of *H. verticillata* at lakes Lucerne and Pipe is the only known infestation in the Pacific Northwest and marks the northern-most occurrence of the plant in the United States. Upon the positive identification of *H. verticillata* in 1995, eradication actions were quickly begun by King County and the Washington State Department of Ecology. The herbicide fluridone was used in 1995 to reduce the biomass and prevent further reproduction of *H. verticillata*. A detailed diver survey was performed in 1996 to evaluate the success of the 1995 herbicide application. The survey confirmed the substantial reduction of *H. verticillata* (and almost complete eradication of *M. spicatum)*. Maximum biomass of *H. verticillata* was measured during July 1995 and averaged 79 grams/sq. meter. After the 1995 herbicide application, biomass was reduced by 97 percent in 1996. In 1996, even with significant biomass reduction, *H. verticillata* still remained widely

SPECIES PRESENT AND THEIR ABBREVIATIONS

Chara sp.	Cs	Nitella sp.	Ni
Elodea canadensis	Ec	Nymphaea odorata	No
Equisetum sp.	Es	Potamogeton amplifolius	Pa
Hydrilla verticillata	Hv	Potamogeton pusillus	Pb
Iris pseudacorus	Ip	Scirpus sp.	Sb
Juncus sp.	Ju	Spiraea douglasii	Sd
Lythrum salicaria	Ls	Typha latifolia	Tl
Mentha sp.	Mp	Utricularia sp.	Us
Myriophyllum spicatum	Ms	Veronica sp.	Vs
Najas flexilis	Nf		

SPECIES PRESENT IN EACH SECTION

1 ..... Sd, Ip, Ju, Tl, Es, Mp, No, Hv, Pa, Us, Pb, Ni, Nf

2 ..... Ju, Sd, Ip, Mp, No, Nf, Ni, Us, Hv, Pa

3 ..... Ip, Mp, Tl, Ju, No, Pa, Hv, Us, Ni, Ec, Pb

4 ..... Tl, Ip, Ju, Sd, Mp, No, Hv, Pa, Ni, Us, Ms

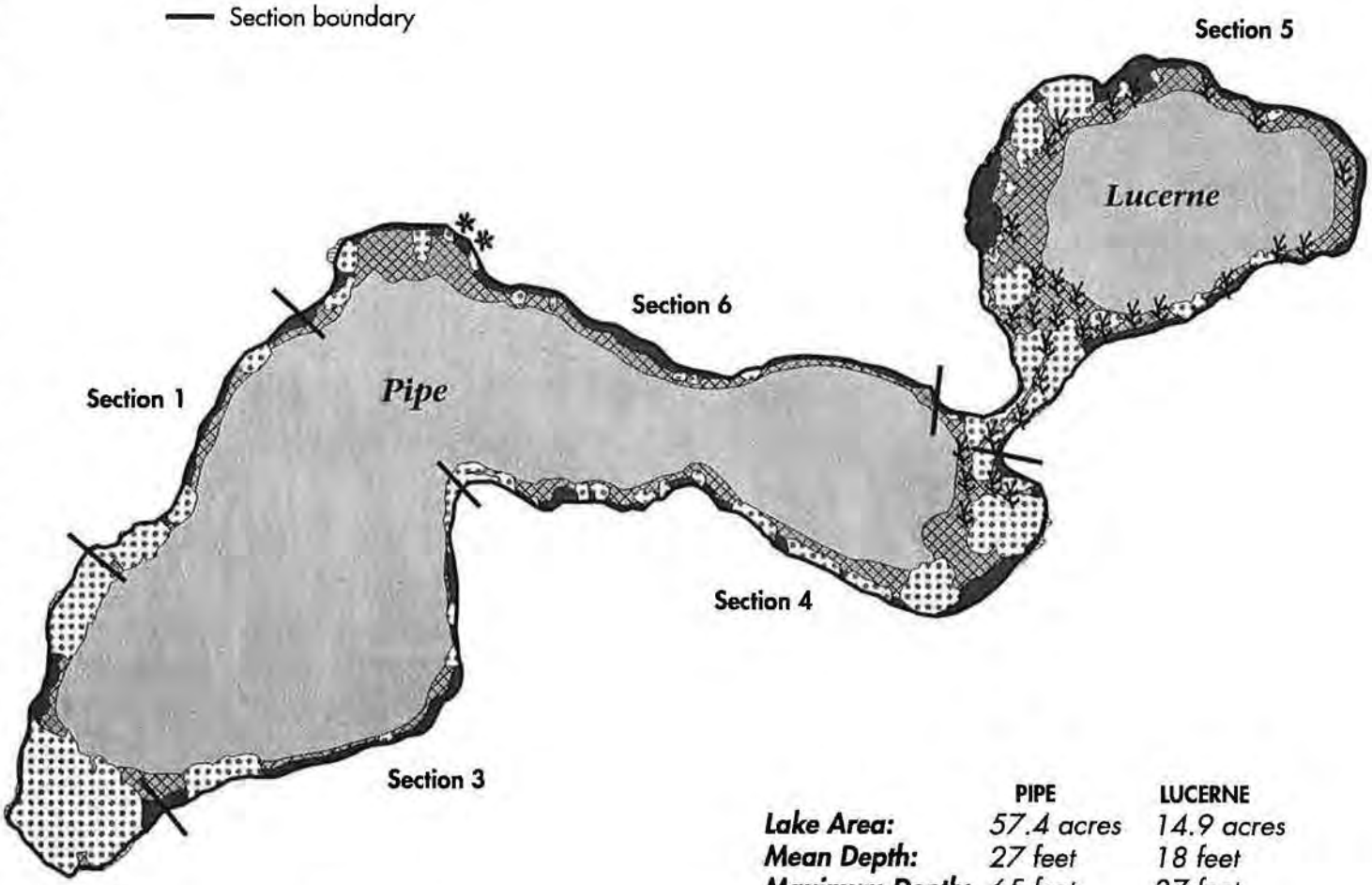
5 ..... Ju, Sd, Mp, Ip, Tl, Vs, No, Hv, Pb, Pa, Ni, Us, Pa, Pb

6 ..... Sd, Ip, Ju, No, Hv, Ni, Us, Pa, Pb, Ls

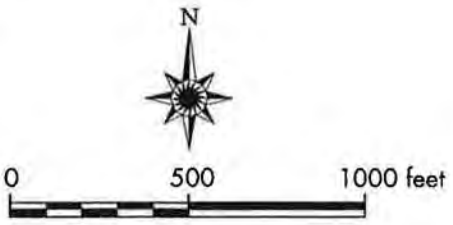
Lucerne/Pipe

Aquatic Plants Map

- Floating
- Emergent
- Submergent
- No plants or sparse
- No plants—deep
- Loosestrife
- Milfoil
- Shoreline
- Section boundary



	PIPE	LUCERNE
Lake Area:	57.4 acres	14.9 acres
Mean Depth:	27 feet	18 feet
Maximum Depth:	65 feet	37 feet



NOTE: At the time of the original survey, specific location information on hydrilla was not recorded on the field map. However, section species list from the 1994 survey and subsequent diver surveys in 1995 showed hydrilla to be distributed throughout the entire submergent plant zone.

distributed in the lake. Additional herbicide application was performed this year to continue eradication efforts. Management activities will be ongoing at lakes Lucerne and Pipe until *H. verticillata* has been eradicated and the native aquatic plant population has been restored.

Pipe Lake was previously surveyed in 1976, 1978, and 1979 (Metro 1976, 1978, and 1979). *Nymphaea odorata*, and *Potamogeton sp.*, were the most common plants found in the lake based on the three surveys. The floating plant coverage for Pipe Lake was 4.5 acres in 1976, 3.2 acres in 1978, and 5.6 acres in 1979. Species observed in previous surveys but were not observed during the 1994 survey include: *Brasenia schreberi, Fontinalis sp., Isoetes sp., Nuphar lutea*, and *Potamogeton epihydrus*.

Margaret

Margaret Lake was surveyed on August 22, 1995. Secchi depth was 4.0 meters. The weather during the survey was sunny. Thirteen plant species (listed below) were identified including seven emergent types and six submergent types. No floating plants were observed. The submergent community comprised 9.6 acres. In all sections, percent cover was less than 25 percent for the submergent community. Submergents could be found growing to a water depth of two meters.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Callitriche sp.	Cp	Nitella sp.	Ni
Carex sp.	Ca	Polygonum sp.	Pm
Chara sp.	Cs	Potamogeton pusillus	Pb
Elodea canadensis	Ec	Sparganium sp.	Sf
Iris pseudacorus	Ip	Spiraea douglasii	Sd
Juncus sp.	Ju	Typha latifolia	Tl
Myriophyllum sp.	My		

SPECIES PRESENT IN EACH SECTION

1 ..... Sd, Ju. Ec, Ni, Cp

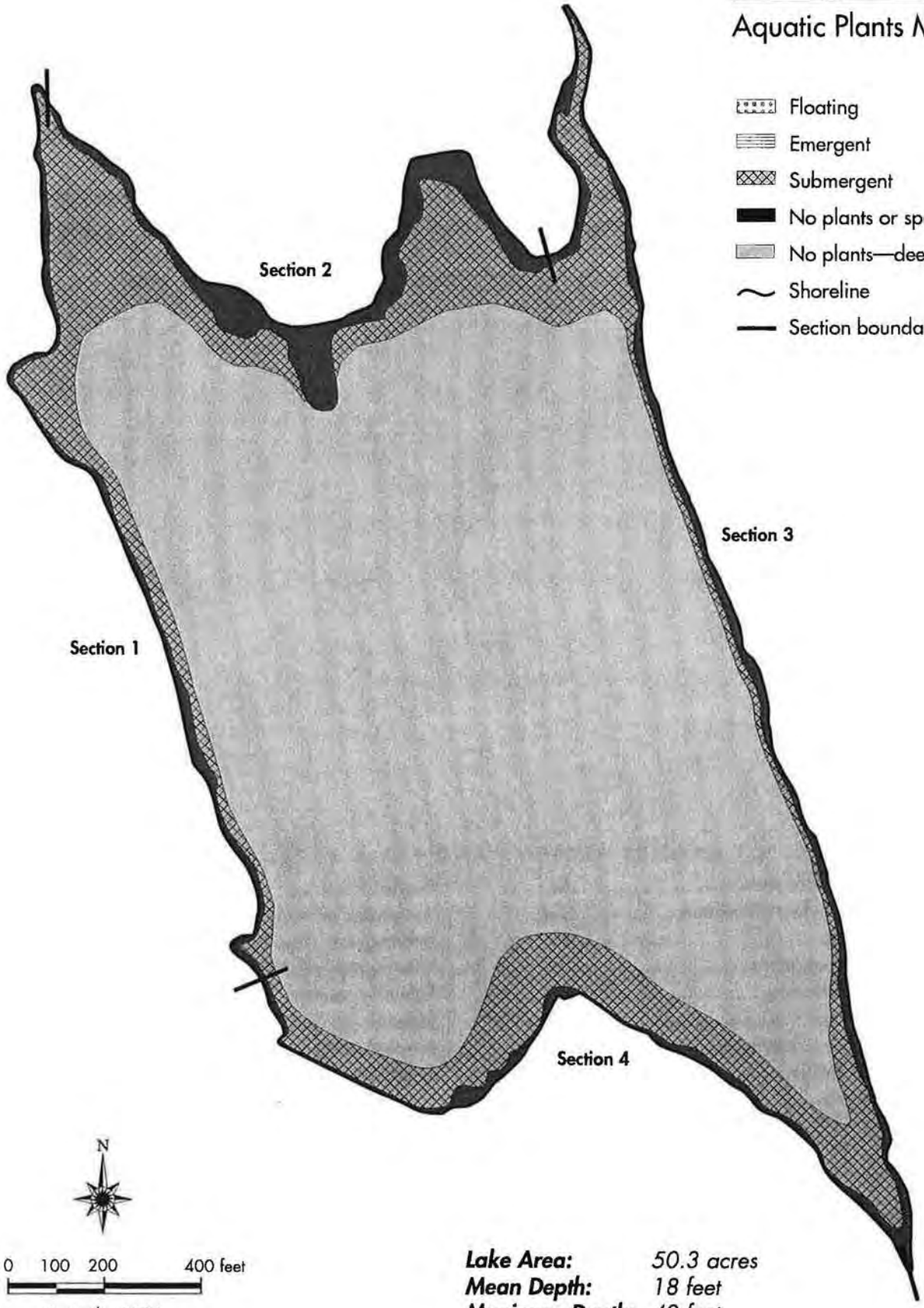
2 ..... Ju, Sd, Ip, Pm, Ec, Pb

3..... Ca, Sd, Ip, Ju, My, Ec, Cp,

4..... Sf, Tl, Sd, Ju, Ec, My

Margaret

Aquatic Plants Map



September 1996

Lake Area: *50.3 acres*
Mean Depth: *18 feet*
Maximum Depth: *43 feet*

McDonald

Lake McDonald was surveyed on August 16, 1995. Secchi depth was 2.0 meters. The weather during the survey was clearing, becoming sunny. Seventeen plant species (listed below) were identified including eight emergent types, three floating types, and six submergent types. The floating plant coverage totaled 2.3 acres while the submergent community comprised 2.9 acres. Percent cover was typically between 25 and 75 percent for the floating community and was less than 25 percent for the submergent community. Submergents could be found growing to a water depth of three meters.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Brasenia schreberi	Bs	Nuphar lutea	Nl
Ceratophyllum demersum	Cd	Nymphaea odorata	No
Chara sp.	Cs	Potamogeton amplifolius	Pa
Elodea canadensis	Ec	Potamogeton pusillus	Pb
Iris pseudacorus	Ip	Potentilla palustris	Pp
Juncus sp.	Ju	Solanum sp.	Sn
Ludwigia palustris	Lp	Spiraea douglasii	Sd
Najas flexilis	Nf	Typha latifolia	Tl
Nitella sp.	Ni		

SPECIES PRESENT IN EACH SECTION

1 ..... Ip, Sd, Sn, Tl, No, Nl, Bs, Cd, Pa, Ec, Nf, Ni

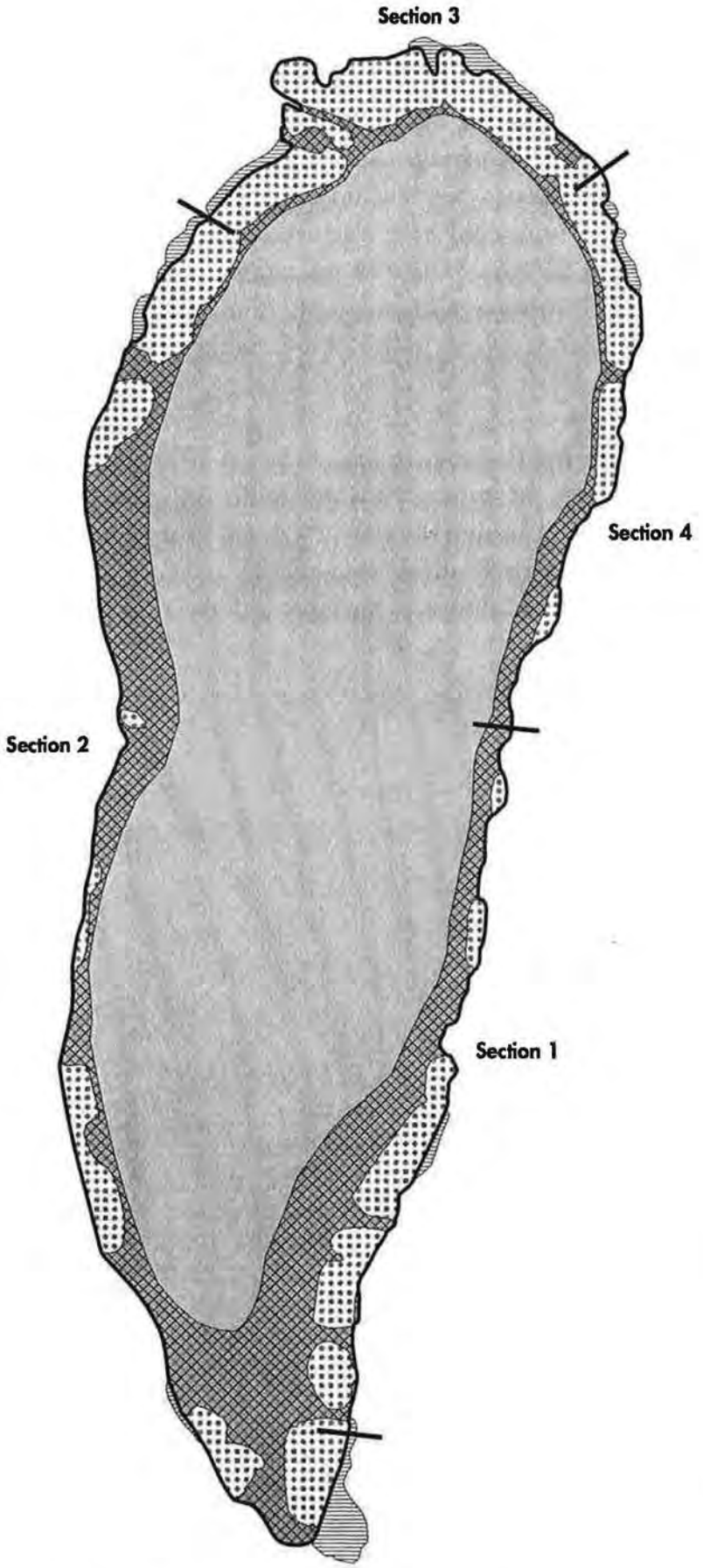
2 ..... Ip, Sd, No, Bs, Cd, Pa, Pb, Ec Ni

3 ..... Ip, Pp, Sd, Tl, Lp, No, Nl, Bs, Ec, Nf, Pp, Cd, Ni, Pb

4 ..... Ip, Sd, Ju, Pp, No, Nl, Bs, Cd, Ec, Pa

McDonald

Aquatic Plants Map



- Floating
- Emergent
- Submergent
- No plants or sparse
- No plants—deep
- Shoreline
- Section boundary

Lake Area: *17.1 acres*
Mean Depth: *23 feet*
Maximum Depth: *47 feet*

N

0 100 200 400 feet

September 1996

Meridian

Lake Meridian was surveyed on August 1, 1994. Secchi depth was 5.0 meters. Sky conditions were sunny. Nineteen plant species (listed below) were identified including seven emergent types, two floating types, and ten submergent types. The floating plant coverage totaled 5.3 acres while the submergent community comprised 25.4 acres. Percent cover was less than 25 percent for the floating community and between 25 and 75 percent for the submergent community. Emergent vegetation coverage was very limited due to extensive shoreline development. *Myriophyllum spicatum* was the most abundant species in the lake, forming a continuous band at a depth between one and three meters.

Lake Meridian's aquatic plants were surveyed for five consecutive years between 1976 through 1980 (Metro, 1976; 1977; 1978; 1979; and 1980). *M. spicatum* was the dominant species noted in the historical surveys, forming a continuous band around the lake to a depth of three to four meters. Limited herbicide use was noted in the 1976 survey. *Potamogeton pusillus* and *Brasenia schreberi* were two species noted in the historical surveys but were not observed in the 1994 SWM survey.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Ceratophyllum demersum	Cd	Nymphaea odorata	No
Chara sp.	Cs	Potamogeton amplifolius	Pa
Elodea canadensis	Ec	Potamogeton epihydrus	Pe
Iris pseudacorus	Ip	Potamogeton richardsonii	Pi
Juncus sp.	Ju	Potamogeton zosteriformis	Pz
Lythrum salicaria	Ls	Potentilla palustris	Pp
Myriophyllum spicatum	Ms	Spiraea douglasii	Sd
Najas flexilis	Nf	Typha latifolia	Tl
Nitella sp.	Ni	Utricularia sp.	Us
Nuphar lutea	Nl		

SPECIES PRESENT IN EACH SECTION

1 ..... Ip, No, Pi, Nl, Ec, Pa, Ni, Nf

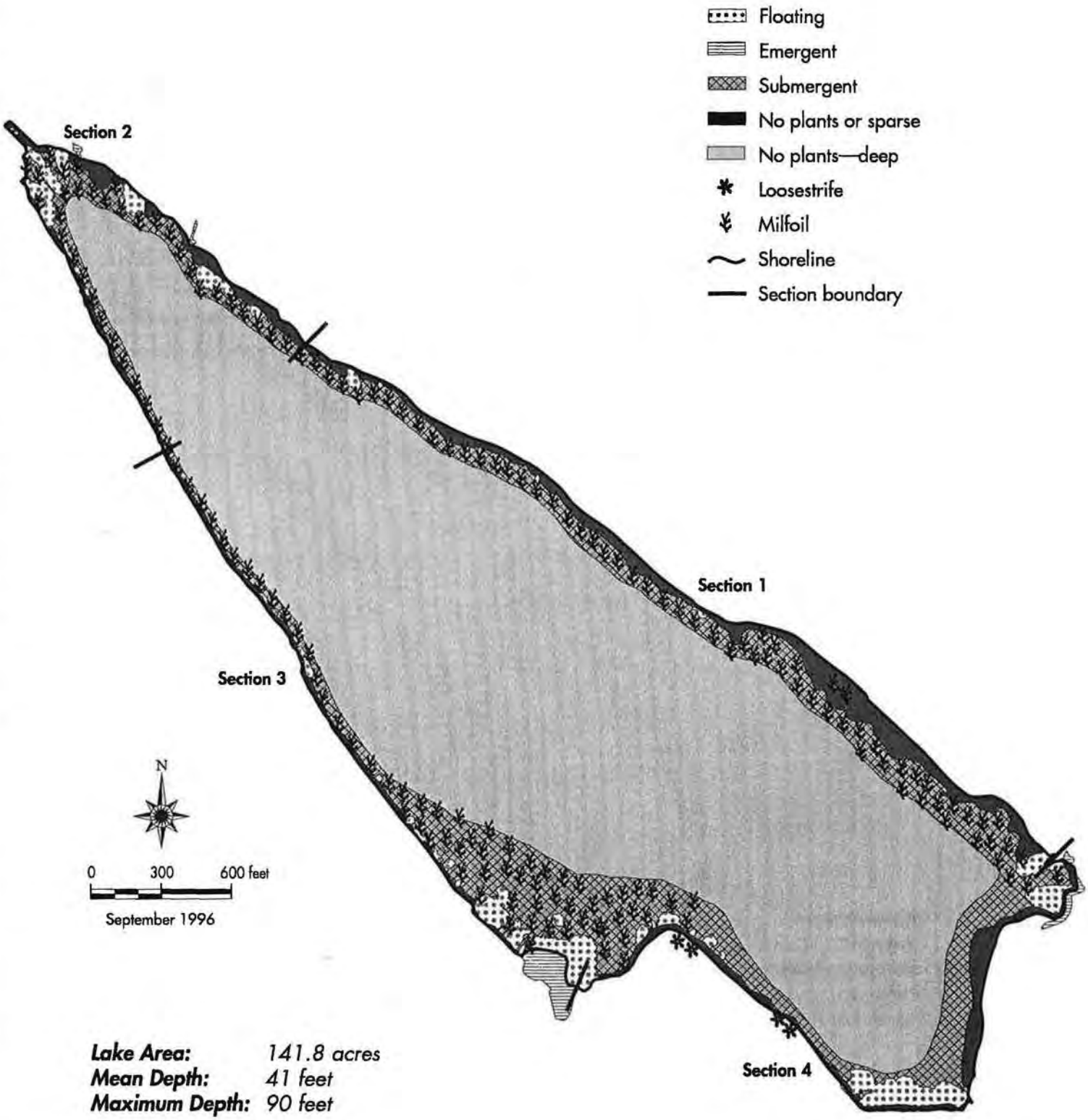
2 ..... Ip, Ju, No, Ms, Pi, Ni, Pe, Ec, Pa

3 ..... Ip, Sd, Tl, Pp, No, Ms, Pi, Pa, Pe, Cd, Ec, Ni

4 ..... Ip, Sd, Pp, No, Nl, Ms, Pe, Ni, Pi, Ec, Ls

Meridian

Aquatic Plants Map



Lake Area: *141.8 acres*
Mean Depth: *41 feet*
Maximum Depth: *90 feet*

Morton

Lake Morton was surveyed on August 24, 1994. The survey team was assisted by Lake Morton residents Delbert Hesseltine and Robert Wagner. Secchi depth was 3.1 meters. Sky conditions were sunny. Nine plant species (listed below) were identified including six emergent types, two floating types, and one submergent type. The floating plant coverage totaled 1.4 acres while the submergent community was limited to one clump of *Nitella sp*. In all sections, percent cover was less than 25 percent. Emergent vegetation coverage was limited by shoreline development.

Lake Morton was previously surveyed in 1976 and 1978 (Metro 1976 and 1978). The submergent plant coverage was 30 acres in both 1976 and 1978. This areal coverage is substantially greater than what was mapped in 1995. Lake residents, Delbert Hesseltine and Robert Wagner, were not aware of any recent herbicide use which could account for the absence of submergent plants during the 1994 SWM survey. Other submergent species noted in historical surveys included *Chara sp. Elodea canadensis*, and *Potamogeton pusillus*.

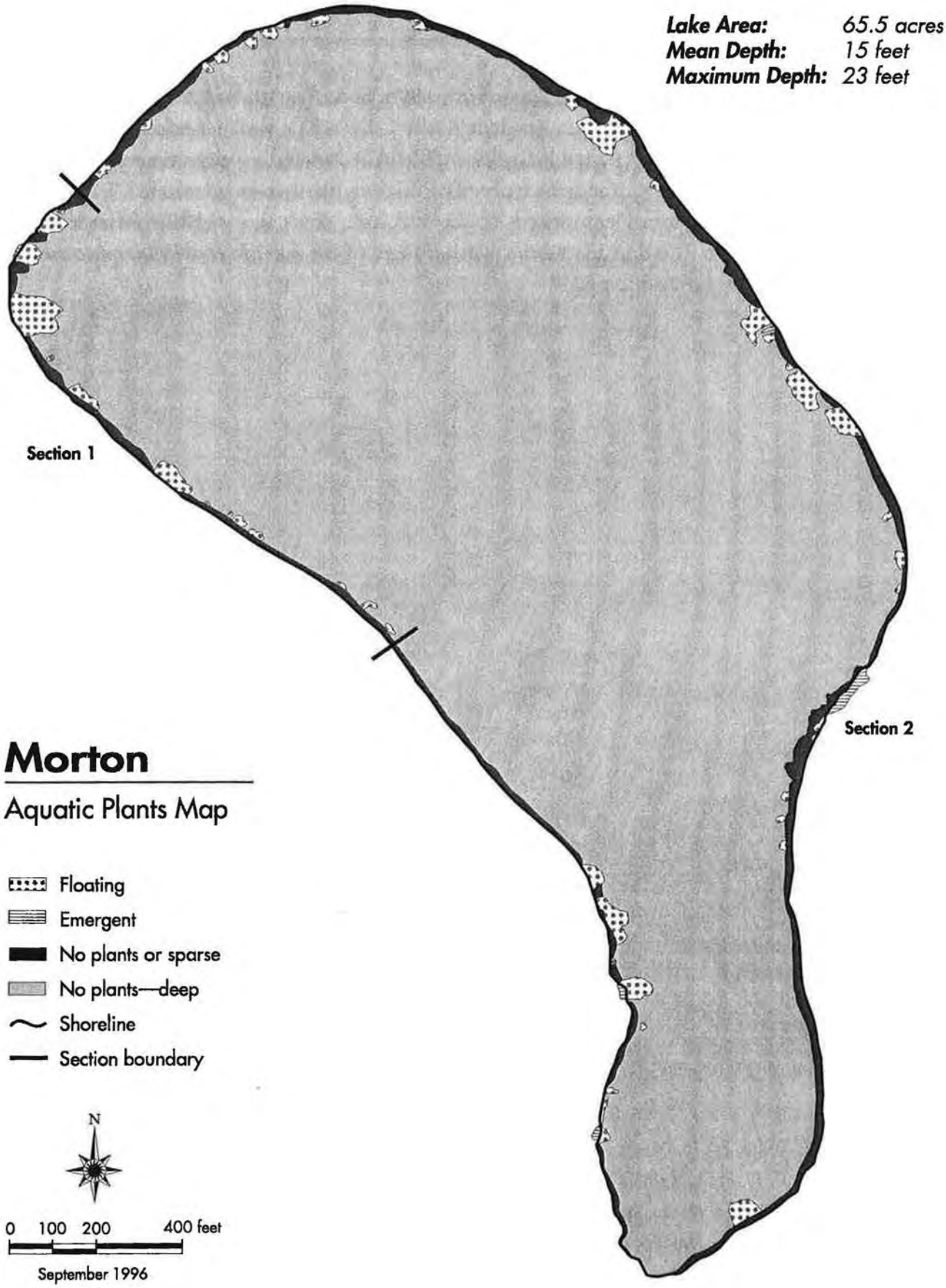
SPECIES PRESENT AND THEIR ABBREVIATIONS

Iris pseudacorus	Ip	Nymphaea odorata	No
Juncus sp.	Ju	Potentilla palustris	Pp
Ludwigia palustris	Lp	Spiraea douglasii	Sd
Nitella sp.	Ni	Typha latifolia	Tl
Nuphar lutea	Nl		

SPECIES PRESENT IN EACH SECTION

1 ..... Tl, Ip, Sd, No, Nl

2 ..... Ju, Tl, Sd, Pp, Lp, Nl, No, Ni


Lake Area: 65.5 acres
Mean Depth: 15 feet
Maximum Depth: 23 feet
Section 1
Section 2
Morton
Aquatic Plants Map
Floating
Emergent
No plants or sparse
No plants—deep
Shoreline
Section boundary
N
0 100 200 400 feet
September 1996

Neilson (Holm)

Neilson Lake was surveyed on August 26, 1994. Secchi depth was 2.5 meters. The survey team was assisted by Neilson Lake resident Kathy Culver. The weather was sunny during the survey. Eighteen plant species (listed below) were identified including eight emergent types, three floating types, and seven submergent types. The floating plant coverage totaled 2.1 acres while the submergent community comprised 2.6 acres. Percent cover was variable from section to section. Wetland vegetation dominated the northern end of the lake. *Myriophyllum spicatum* was found in a few areas around the lake.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Brasenia schreberi	Bs	Nitella sp.	Ni
Callitriche sp.	Cp	Nuphar lutea	Nl
Chara sp.	Cs	Nymphaea odorata	No
Elodea canadensis	Ec	Potamogeton pusillus	Pb
Iris pseudacorus	Ip	Potentilla palustris	Pp
Juncus sp.	Ju	Sagittaria sp.	Sa
Ludwigia palustris	Lp	Spiraea douglasii	Sd
Menyanthes trifoliata	Mt	Typha latifolia	Tl
Myriophyllum spicatum	Ms	Utricularia minor	Um

SPECIES PRESENT IN EACH SECTION

1 ..... Tl, Sd, Pp, Ip, Nl, No, Bs, Lp, Ec, Um, Pb

2 ..... Tl, Ju, Pp, Ip, No, Nl, Bs, Ni, Ec, Lp, Um, Ms, Cp

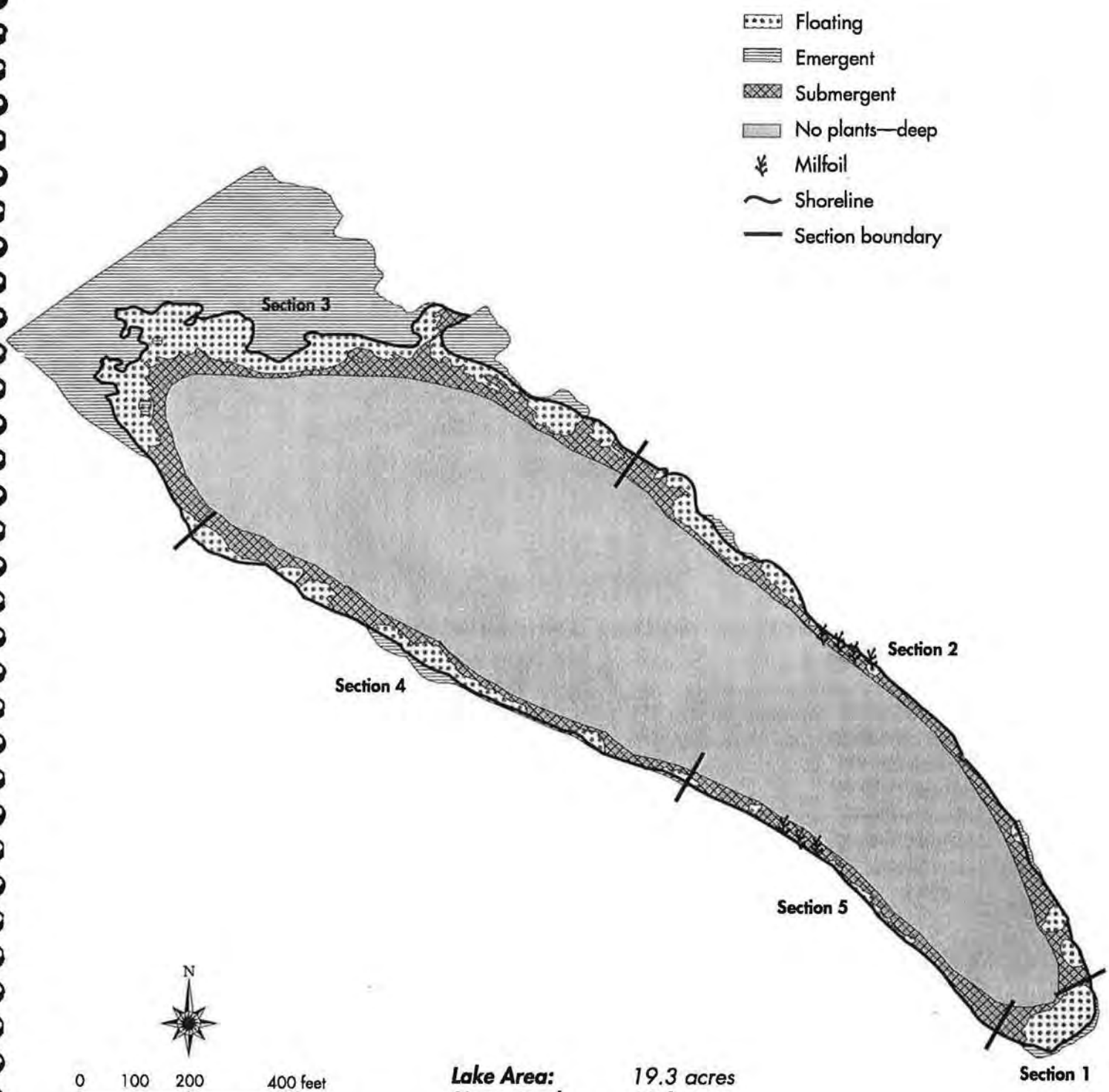
3 ..... Tl, Ip, Sd, Mt, Ju, Pp, No, Nl, Bs, Ec, Pb, Ni, Um

4 ..... Sa, Sd, Ip, Mt, Pp, Tl, No, Nl, Bs, Ec, Um, Lp, Ni

5 ..... Tl, Ju, Ip, Sd, Nl, Bs, Ec, Lp, Um, Ms

Nielson (Holm)

Aquatic Plants Map



Lake Area: *19.3 acres*
Mean Depth: *18 feet*
Maximum Depth: *31 feet*

North

North Lake was surveyed on July 26, 1995. Secchi depth was 2.8 meters. The survey team was assisted by Cassandra Robertson. The weather was clearing becoming sunny during the survey. Nineteen plant species (listed below) were identified including eight emergent types, three floating types, and eight submergent types. The floating plant coverage totaled 14.4 acres while the submergent community comprised 20.7 acres. In sections 1 and 2, percent cover was less than 25 percent for floating and submergent communities. In the remaining sections coverage was less than 25 percent or between 25 and 75 percent. Submergent vegetation could be found to a depth of almost four meters. Emergent vegetation coverage was fairly limited by shoreline development along the eastern shoreline while the western shoreline remains largely vegetated. *Lythrum salicaria* can be found along the entire shoreline area.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Brasenia schreberi	Bs	Nuphar lutea	Nl
Chara sp.	Cs	Nymphaea odorata	No
Eleocharis sp.	El	Potamogeton amplifolius	Pa
Elodea canadensis	Ec	Potamogeton epihydrus	Pe
Iris pseudacorus	Ip	Potentilla palustris	Pp
Ludwigia palustris	Lp	Scirpus sp.	Sb
Lythrum salicaria	Ls	Spiraea douglasii	Sd
Myriophyllum sp.	My	Typha latifolia	Tl
Najas flexilis	Nf	Utricularia vulgaris	Uv
Nitella sp.	Ni		

SPECIES PRESENT IN EACH SECTION

1 ..... Sb, Ls, Lp, Tl, Pp, Sd, No, Bs, My, Uv, Ni, Ec, Pa

2 ..... Ls, Lp, Sd, Ip, Sb, No, Pa, My, Ec, Uv

3 ..... Sd, Tl, Ls, Pp, Sb, Lp, Nl, No, Pa, Uv, My, Ni, Nf

4 ..... Pp, Sb, Sd, Ls, Bs, No, Nl, Pa, My, El, Ni

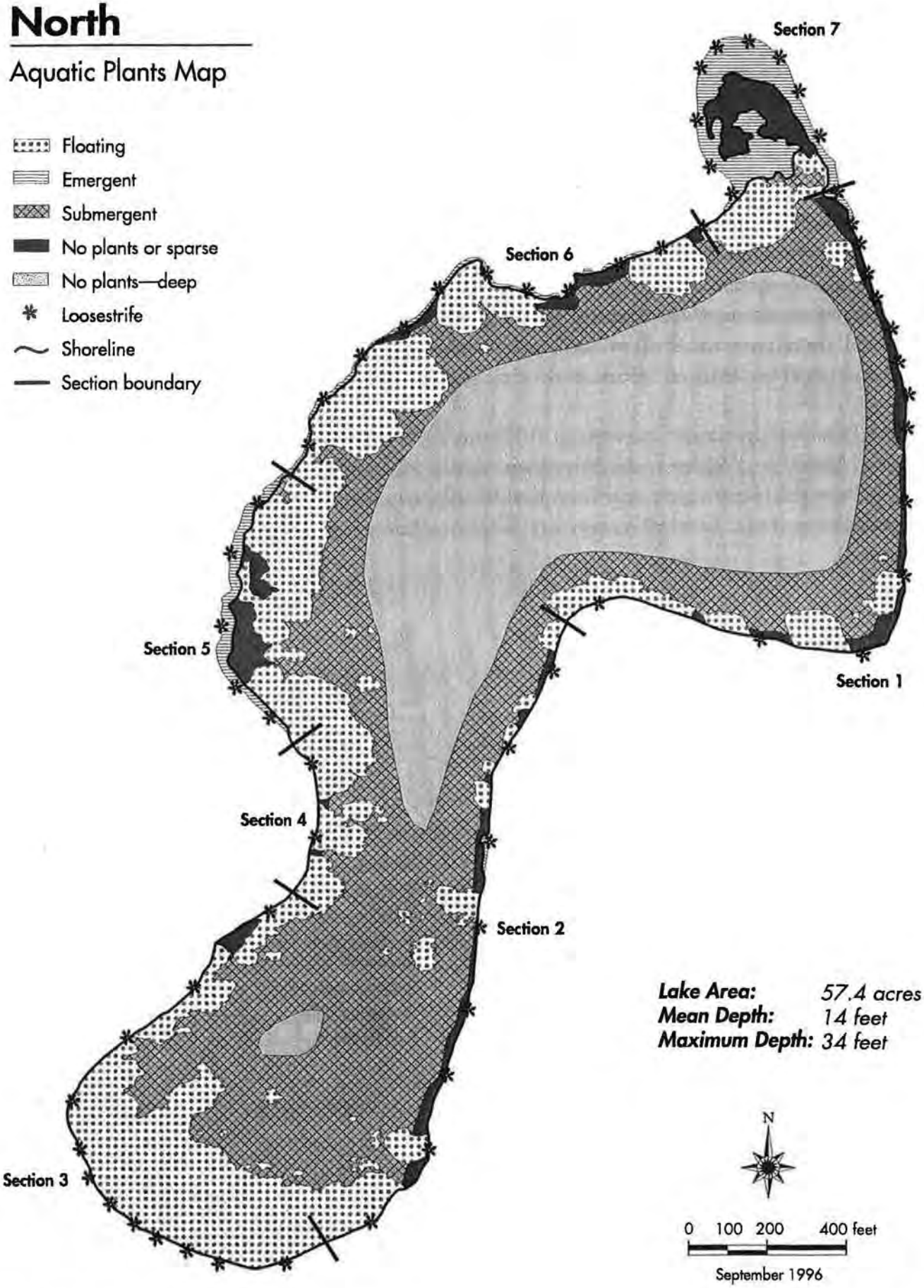
5 ..... Sb, Ls, Sd, No, Nl, Uv, My

6 ..... Ls, Sd, Lp, Sb, Nl, No, My, Ec, Ni, Pe, Uv, El

7 ..... Sb, Ls, Tl, Pp, Lp, No, Nl, El, Uv, My, Nf

North

Aquatic Plants Map



Panther

Panther Lake was surveyed on July 27, 1995. Secchi depth was 0.3 meters and highly colored by organic acids. Sky conditions were sunny.

Seventeen plant species (listed below) were identified including nine emergent types, three floating types, and five submergent types. The floating plant coverage totaled 22.8 acres while the submergent community comprised 4.8 acres. In most sections, percent cover was typically greater than 75 percent. Submergent vegetation could be found to a depth of 2 meters. Emergent vegetation coverage was extensive with limited shoreline development. Wetland vegetation, in general, dominates this shallow lake. *Lythrum salicaria* was found in limited areas of Section 2 and 3 and could be removed before more of the shoreline becomes infested.

Panther Lake was previously surveyed in 1976 and 1978 (Metro 1976 and 1978). *Brasenia schreberi, Nitella sp., Nuphar lutea, Nymphaea odorata, Potamogeton natans,* and *Utricularia vulgaria* were the plants commonly found in the lake based on these surveys. The lake was not mapped during these historical surveys so floating and submergent plant coverage cannot be compared.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Brasenia schreberi	Bs	Nymphaea odorata	No
Dulichium arundinaceum	Da	Polygonum sp.	Pm
Iris pseudacorus	Ip	Potamogeton pusillus	Pb
Juncus sp.	Ju	Potamogeton natans	Pn
Ludwigia palustris	Lp	Potentilla palustris	Pp
Lythrum salicaria	Ls	Spiraea douglasii	Sd
Najas flexilis	Nf	Typha latifolia	Tl
Nitella sp.	Ni	Utricularia sp.	Us
Nuphar lutea	Nl		

SPECIES PRESENT IN EACH SECTION

1 ..... Ju, Sd, Pp, Pm, Lp, Ip, Tl, Nl, No, Bs, Us, Ni

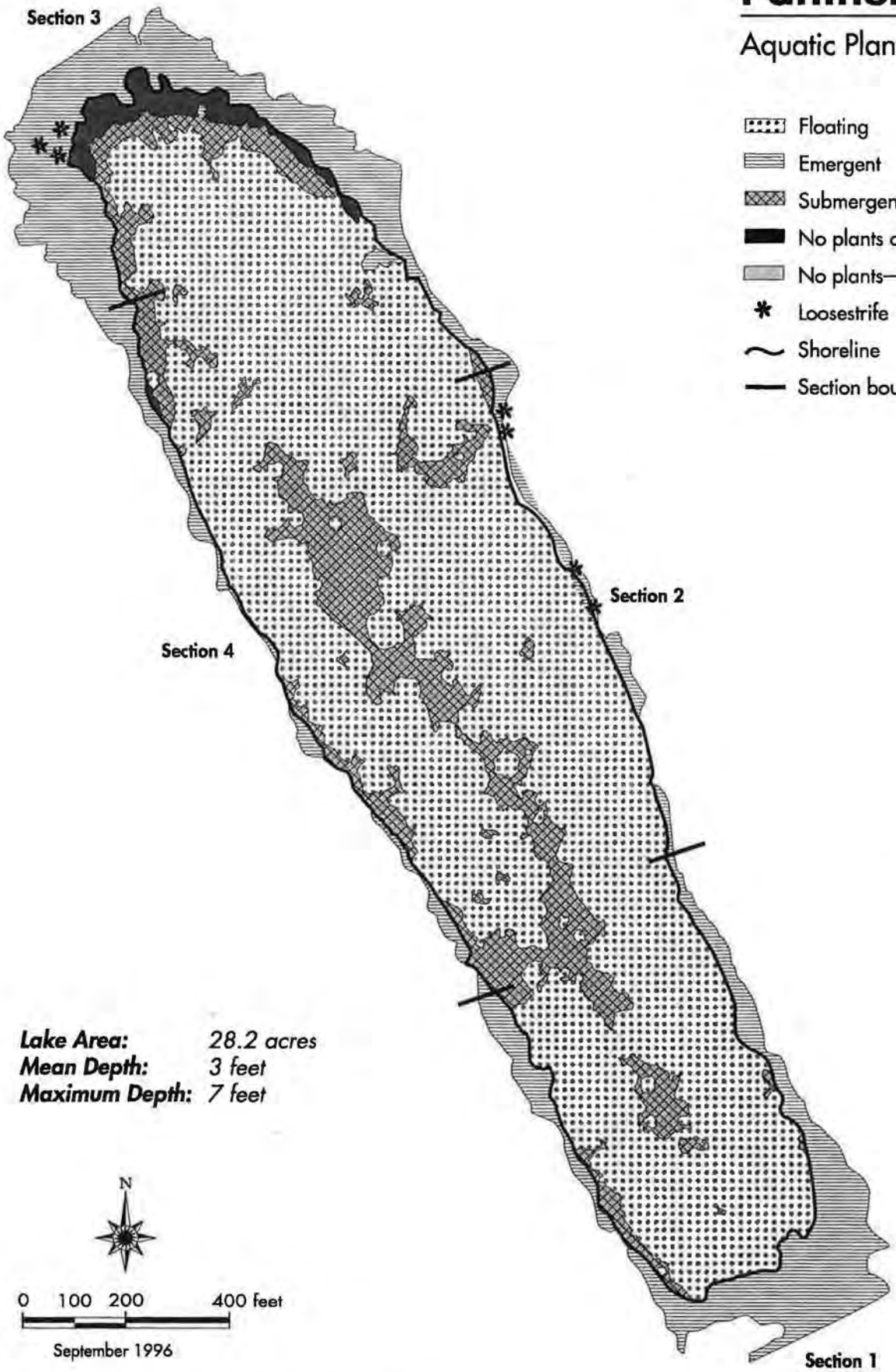
2 ..... Ju, Sd, Pp, Pm, Lp, Ip, Tl, Ls, Nl, No, Bs, Us, Ni, Pn, Nf

3 ..... Ju, Sd, Ls, Tl, Pp, Pm, Lp, Ip, Nl, No, Bs, Us, Ni, Pn

4 ..... Ju, Sd, Tl, Ip, Pp, Nl, No, Bs, Us, Pm, Lp

Panther

Aquatic Plants Map



Lake Area: *28.2 acres*
Mean Depth: *3 feet*
Maximum Depth: *7 feet*

Pine

Pine Lake was surveyed on August 15, 1994. Secchi depth was 5.0 meters. Sky conditions were cloudy. Ten plant species (listed below) were identified including four emergent types, two floating types, and four submergent types. The floating plant coverage totaled 1.7 acres while the submergent community comprised 15.7 acres. Percent cover was typically less than 25 percent for the floating and submergent communities. Emergent vegetation coverage was very limited due to extensive shoreline development. *Lythrum salicaria* was found in several patches in Section 7 only and could be easily removed from the lake.

Pine Lake aquatic plants were surveyed for four of the five years between 1976 through 1980 (Metro, 1976; 1978; 1979; and 1980). In past surveys, floating plant coverage has ranged between three and four acres while floating and submerged plant coverage (combined in historic coverage information) has ranged from 21 to 26 acres. Based on current coverage, both floating plant coverage and combined coverage of aquatic plants is reduced from historical levels. *Brasenia schreberi, Ceratophyllum demersum, Isoetes sp., Nitella sp.* and *Potamogeton pusillus* were noted in the historical surveys but were not observed in the 1994 SWM survey.

SPECIES PRESENT AND THEIR ABBREVIATIONS

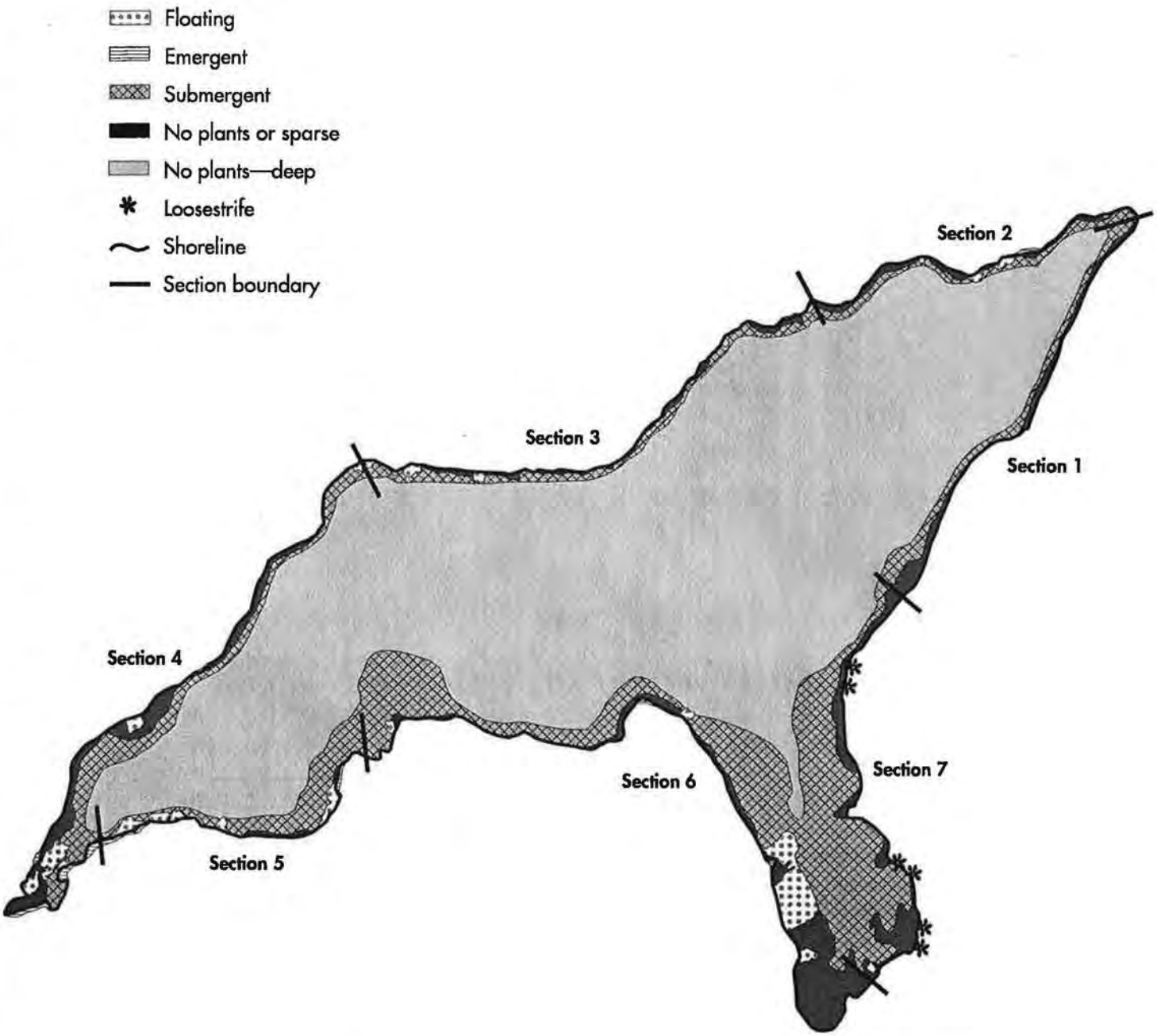
Elodea canadensis	Ec	Nuphar lutea	Nl
Iris pseudacorus	Ip	Nymphaea odorata	No
Juncus sp.	Ju	Potamogeton amplifolius	Pa
Lythrum salicaria	Ls	Potamogeton pusillus	Pb
Najas flexilis	Nf	Spiraea douglasii	Sd

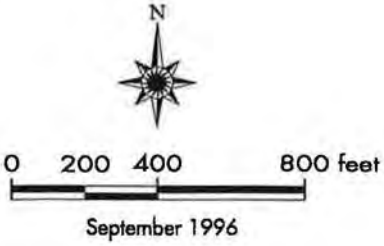
SPECIES PRESENT IN EACH SECTION

1 ..... Sd, Ip, Nl, No, Pa, Ec, Nf	5 ..... Sd, Ip, Ju, Nl, Pa, Nf, Ec, Pb,
2 ..... No, Pa, Pb, Ec	6 ..... Sd, Ip, No, Nl, Pb, Ec, Pa, Nf
3 ..... Sd, Ju, Ip, No, Pa, Ec	7 ..... Ls, Ju, Ec, Nf, Pb
4 ..... Sd, Ip, Nl, Pa, Pb, Nf, Ec	.....

Pine

Aquatic Plants Map





Lake Area: *84.5 acres*
Mean Depth: *20 feet*
Maximum Depth: *39 feet*

Ravensdale

Ravensdale Lake was surveyed on August 10, 1995. Secchi depth was equal to the lake depth of 4.0 meters. The survey team was assisted by Ravensdale Lake resident Mike. The weather was cloudy and rainy during the survey. Twenty-two plant species (listed below) were identified including 11 emergent types, two floating types, and nine submergent types. The floating plant coverage totaled 0.9 acres while the submergent community comprised 12.9 acres. In most sections, percent cover was typically less than 25 percent. Submergent vegetation could be found to a depth of three meters. Emergent vegetation coverage was fairly extensive due to limited shoreline development for residential uses.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Carex sp.	Ca	Potamogeton amplifolius	Pa
Chara sp.	Cs	Potamogeton pusillus	Pb
Fontinalis sp.	Fo	Potamogeton epihydrus	Pe
Hippuris vulgaris	Hi	Potamogeton gramineus	Pg
Juncus sp.	Ju	Potentilla palustris	Pp
Ledum groenlandicum	Lg	Ranunculus sp.	Rs
Lemma minor	Lm	Scirpus sp.	Sb
Lysichitum americanum	Lc	Solanum sp.	Sn
Mentha sp.	Mp	Sparganium sp.	Sf
Nitella sp.	Ni	Spiraea douglasii	Sd
Nuphar lutea	Nl	Typha latifolia	Tl

SPECIES PRESENT IN EACH SECTION

1 ..... Sd, Lg, Pp, Hi, Mp, Sf, Ju, Pa, Cs, Pb

2 ..... Sn, Ju, Lm, Sd, Pp, Ju, Mp, Sb, Lg, Hi, Tl, Nl, Pa, Pb, Cs

3 ..... Tl, Pp, Sd, Mp, Nl, Cs, Pa, Rs

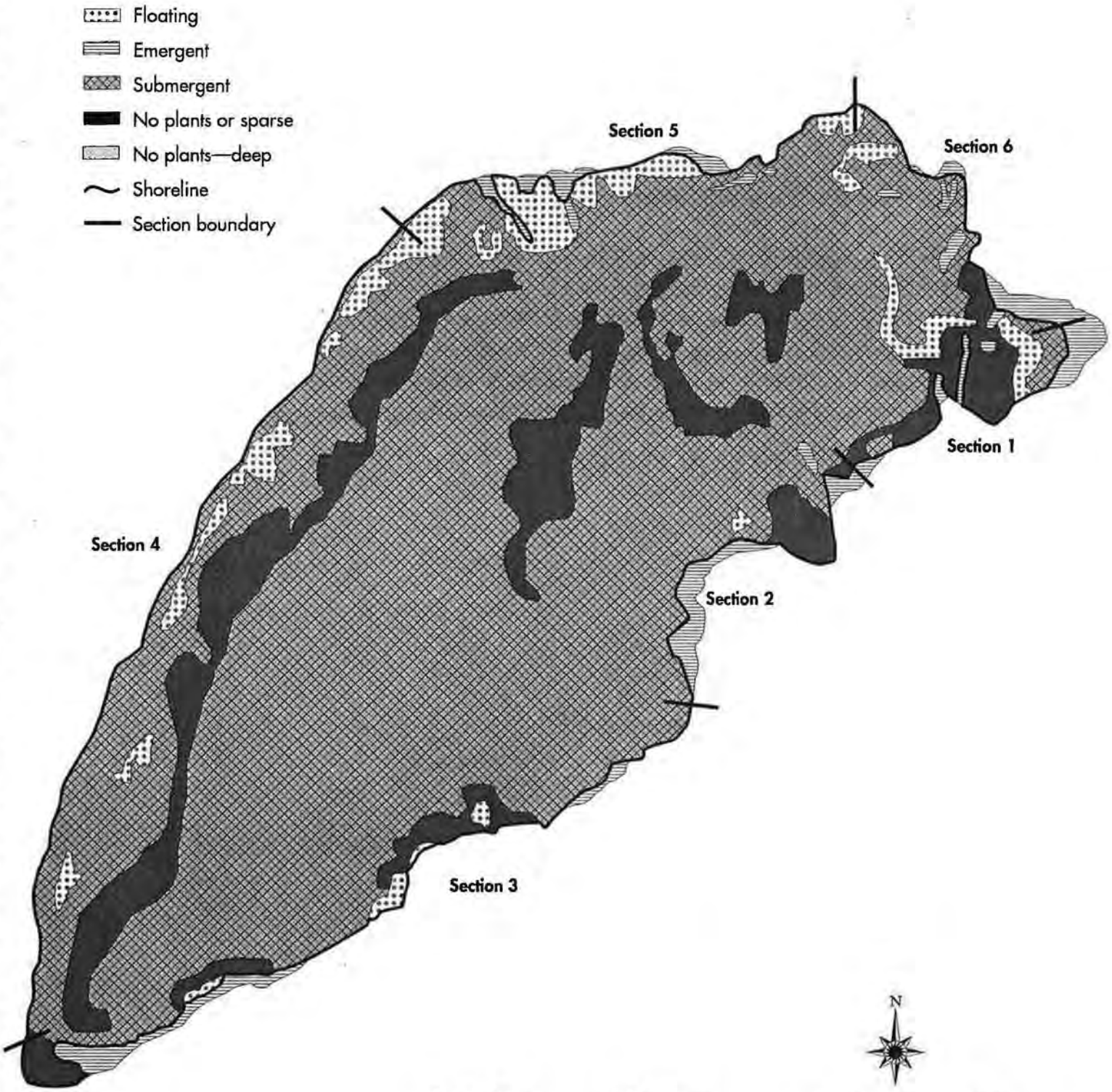
4 ..... Ju, Sf, Tl, Sd, Pp, Pa, Cs, Rs

5 ..... Tl, Sd, Pp, Sf, Ju, Lg, Mp, Nl, Pa, Cs, Rs

6 ..... Sd, Hi, Ju, Pp, Tl, Mp, Lg, Pe, Ni, Cs, Rs, Pa, Pg, Sf

Ravensdale

Aquatic Plants Map



Lake Area: *16.3 acres*
Mean Depth: *4 feet*
Maximum Depth: *14 feet*

Retreat

Lake Retreat was surveyed on August 24, 1995. The survey team was assisted by Lake Retreat resident John Froelich. Secchi depth was 5.5 meters with very clear water quality. Sky conditions were partly cloudy. Eleven plant species (listed below) were identified including six emergent types, one floating types, and four submergent types. The floating plant coverage totaled 2.9 acres while the submergent community comprised 11.7 acres. In most sections, percent cover was less than 25 percent. Submergent vegetation was very sparse but could be found to a depth between three and four meters. Emergent vegetation coverage was fairly limited by shoreline development for residential uses.

Lake Retreat was previously surveyed in 1976 and 1978 (Metro 1976 and 1978). *Nymphaea odorata* and *Potamogeton amplifolius* were the most common plants found in the lake based on these surveys. The coverage of *Nymphaea odorata* was 2.3 acres in 1976 and 1.6 acres in 1978. This areal coverage for floating plants is less than what was mapped in 1995 (2.9 acres). Lake residents have used hand-pulling methods to remove lilies (Metro 1978) and may have pulled more plants in past years which accounts for this difference in floating plant coverage.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Chara sp.	Cs	Najas flexilis	Nf
Elodea canadensis	Ec	Nymphaea odorata	No
Hydrocotyle sp.	Hs	Potamogeton amplifolius	Pa
Iris pseudacorus	Ip	Potentilla palustris	Pp
Juncus sp.	Ju	Spiraea douglasii	Sd
Ludwigia palustris	Lp		

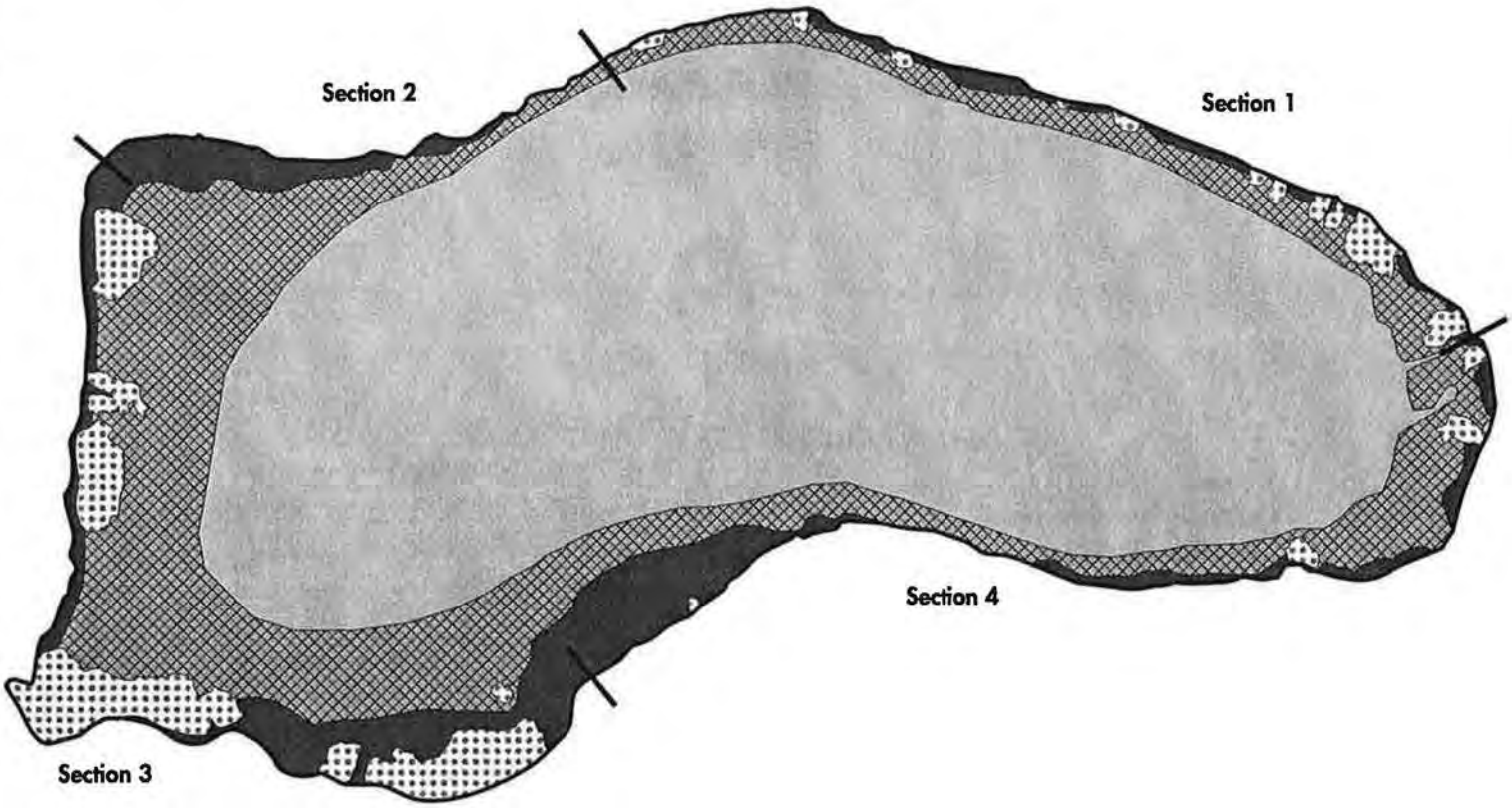
SPECIES PRESENT IN EACH SECTION

1 ..... Ip, Lp, Hs, Sd, Pa	3 ..... Sd, Ip, Ju, No, Pa, Nf, Ec
2 ..... Sd, Ip, Ju, No, Pa	4 ..... Ip, Sd, Lp, Ju, Pp, No, Pa, Cs

Retreat

Aquatic Plants Map

- Floating
- Emergent
- Submergent
- No plants or sparse
- No plants—deep
- Shoreline
- Section boundary



0 100 200 400 feet

September 1996

Lake Area: *51.6 acres*
Mean Depth: *23 feet*
Maximum Depth: *50 feet*

Sawyer

Lake Sawyer was surveyed on August 16, 1994. Secchi depth was 5.0 meters. Sky conditions were partly sunny. Twenty-four plant species (listed below) were identified including seven emergent types, three floating types, and 14 submergent types. The floating plant coverage totaled 8.9 acres while the submergent community comprised 65.7 acres. Percent cover was less than 25 percent for the floating community and between 25 and 75 percent for the submergent community. Emergent vegetation coverage was very limited due to extensive shoreline development. *Myriophyllum spicatum* and *Potamogeton sp.* were the most abundant submergent plants extending to a depth of three meters.

Lake Sawyer's aquatic plants were surveyed for five consecutive years between 1976 through 1980 (Metro, 1976; 1977; 1978; 1979; and 1980). *Myriophyllum spicatum* was the dominant species noted in these historical surveys, forming a continuous band around the lake to a depth of three to four meters. Historical aquatic plant coverage ranged from 86 to 103 acres during the five survey years. *Polygonum amphibium, Potamogeton gramineus* and *Spirodela polyrhiza* were noted in these historical surveys but were not observed during the 1994 SWM survey.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Brasenia schreberi	Bs	Potamogeton amplifolius	Pa
Ceratophyllum demersum	Cd	Potamogeton pusillus	Pb
Chara sp.	Cs	Potamogeton illinoensis	Ps
Elodea canadensis	Ec	Potamogeton pectinatus	Pt
Iris pseudacorus	Ip	Potamogeton praelongus	Pr
Juncus sp.	Ju	Potamogeton richardsonii	Pi
Myriophyllum spicatum	Ms	Potamogeton robbinsii	Po
Najas flexilis	Nf	Potamogeton zosteriformis	Pz
Nitella sp.	Ni	Scirpus sp.	Sb
Nuphar lutea	Nl	Spiraea douglasii	Sd
Nymphaea odorata	No	Typha latifolia	Tl
Polygonum sp.	Pm	Utricularia sp.	Us

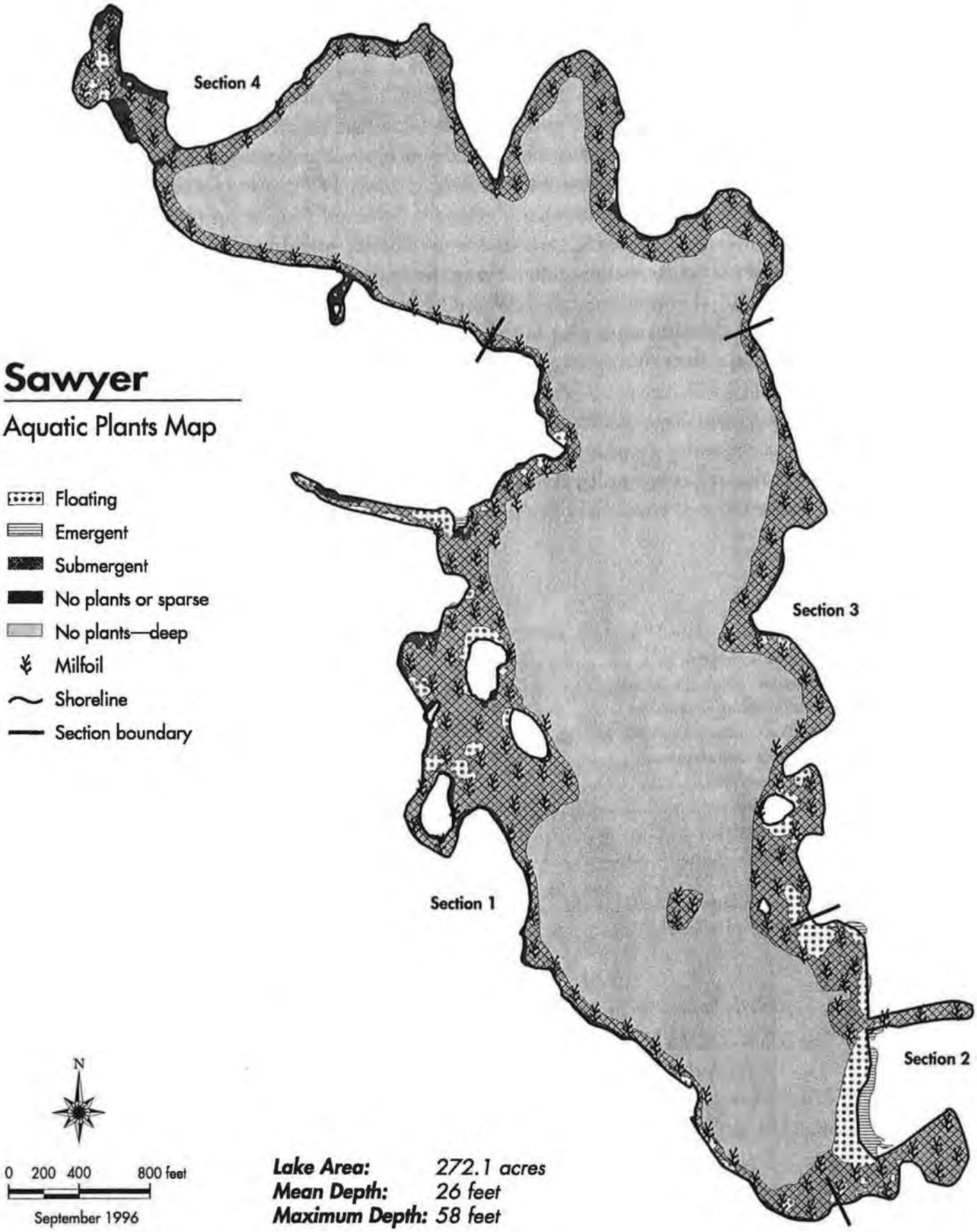
SPECIES PRESENT IN EACH SECTION

1 ..... Ip, Ju, Tl, No, Nl, Pt, Ms, Ni, Cs, Pz, Po, Pb, Ec, Ni

2 ..... Tl, Sd, Ju, Ip, No, Nl, Cd, Pt, Ms, Ec, Ni

3 ..... No, Bs, Pt, Ec, Pz, Po, Us, Cs, Ni, Ms, Pa

4 ..... Tl, Ip, No, Nl, Pt, Pa, Ec, Ms, Pz, Po, Cs, Ni, Nf, Pb, Us


Section 4
Sawyer
Aquatic Plants Map
Floating
Emergent
Submergent
No plants or sparse
No plants—deep
Milfoil
Shoreline
Section boundary
Section 3
Section 1
Section 2
N
0 200 400 800 feet
September 1996
Lake Area: 272.1 acres
Mean Depth: 26 feet
Maximum Depth: 58 feet

Shadow

Shadow Lake was surveyed on July 26, 1994. Secchi depth was 5.0 meters. Sky conditions were sunny. Twenty-three plant species (listed below) were identified including nine emergent types, three floating types, and eleven submergent types. The floating plant coverage totaled 3.2 acres while the submergent community comprised 2.6 acres. Percent cover ranged from less than 25 percent to between 25 and 75 percent for the floating and submergent communities. Emergent vegetation coverage was abundant along the undeveloped western shoreline. The developed areas of the lake were generally buffered by vegetation. *Myriophyllum spicatum* and *Potamogeton sp.* were the most abundant submergent plants extending to a depth of three meters. Shadow Lake's aquatic plants were surveyed for five consecutive years between 1976 through 1980 (Metro, 1976; 1977; 1978; 1979; and 1980). In 1976, *M. spicatum* was found near the boat launch channel and *Najas flexilis* and *Elodea canadensis* were the dominant plants found in the submergent community. *Nuphar varigatum, Nymphaea ordorata,* and *Brasenia schreberi* were all present in the floating community. Based on these surveys, *M. spicatum* spread from the boat launch area, becoming well established in the lake over the course of several years.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Brasenia schreberi	Bs	Najas flexilis	Nf
Carax sp.	Ca	Nitella sp.	Ni
Ceratophyllum demersum	Cd	Nuphar lutea	Nl
Chara sp.	Cs	Nymphaea odorata	No
Dulichium arundinaceum	Da	Potamogeton amplifolius	Pa
Elodea canadensis	Ec	Potamogeton epihydrus	Pe
Fontinalis sp.	Fo	Potamogeton pusillus	Pb
Iris pseudacorus	Ip	Potentilla palustris	Pp
Isoetes sp.	Is	Spiraea douglasii	Sd
Juncus sp.	Ju	Typha latifolia	Tl
Ludwigia palustris	Lp	Utricularia sp.	Us
Myriophyllum spicatum	Ms		

SPECIES PRESENT IN EACH SECTION

1 ..... Sd, Ip, Pp, Ju, No, Bs, Nl, Ni, Pa, Us, Ec, Is

2 ..... Tl, Ip, Pp, No, Bs, Nl, Ec, Ni, Pa

3 ..... Ip, Sd, Ju, No, Bs, Nl, Ms, Ec

4a..... Sd, Ju, Ip, No, Bs, Nl, Pa, Ms, Ec, Nf

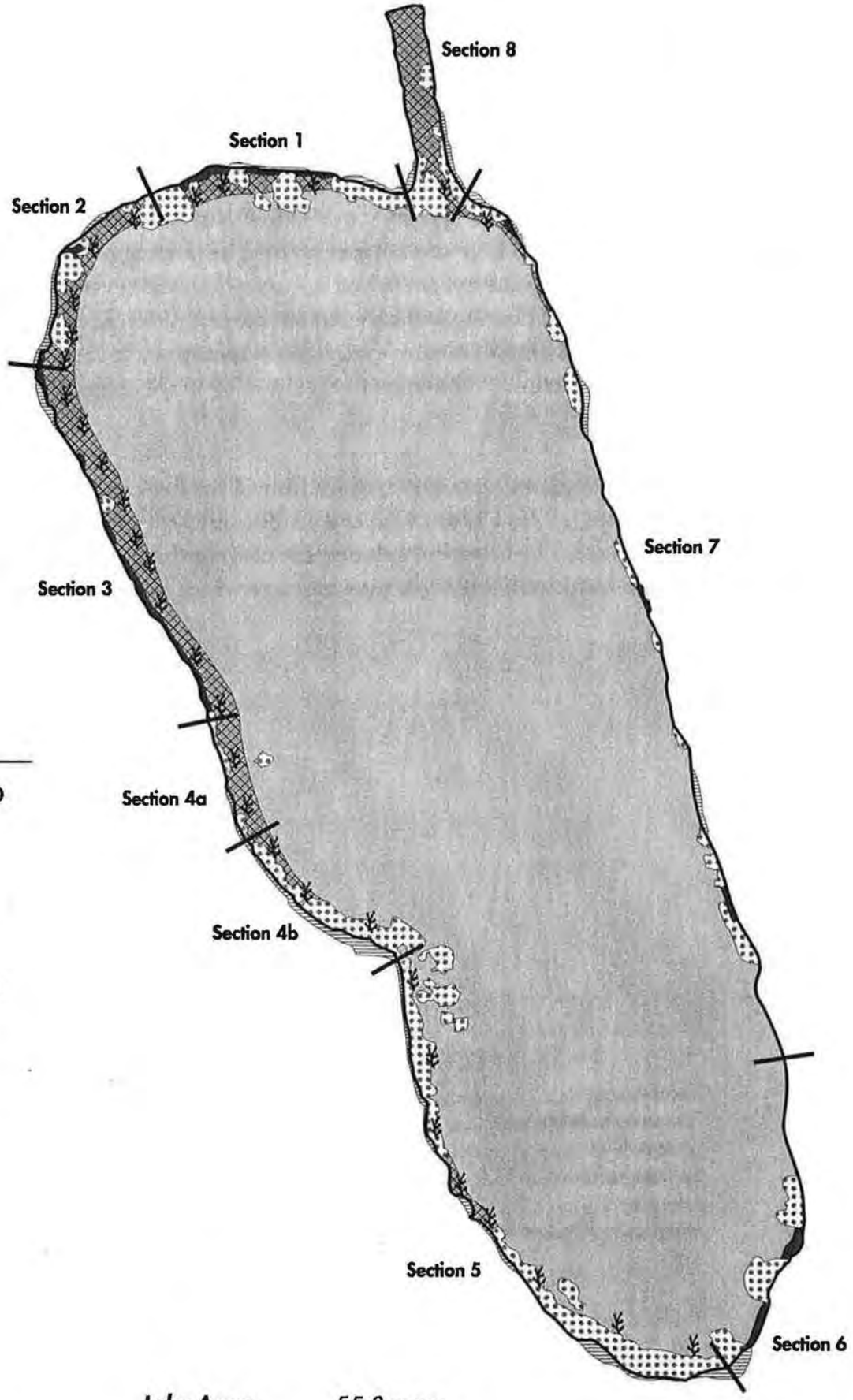
4b..... Sd, Ju, No, Bs, Nl, Ms, Ec, Pa, Us

5 ..... Sd, Ju, No, Bs, Nl, Nf, Ms, Pa, Ec

6 ..... Sd, Ju, Ip, No, Nl

7 ..... Sd, Ip, Ju, Tl, No, Bs, Nl, Ca, Da, Lp

8 ..... Ip, Sd, Tl, No, Nl, Ni, Fo, Pb, Cd, Ec, Pe, Ms, Us



Shadow

Aquatic Plants Map

- Floating
- Emergent
- Submergent
- No plants or sparse
- No plants—deep
- Milfoil
- Shoreline
- Section boundary

N

0 100 200 400 feet

September 1996

Lake Area: *55.8 acres*
Mean Depth: *22 feet*
Maximum Depth: *45 feet*

Shady

Shady Lake was surveyed on July 25, 1994. Secchi depth was 2.8 meters. Sky conditions were overcast. Twelve plant species (listed below) were identified including seven emergent types, one floating type, and four submergent types. The floating plant coverage totaled one acre while the submergent community comprised 2.7 acres. Percent cover typically ranged between 25 and 75 percent for the floating and submergent communities. Emergent vegetation coverage was limited by shoreline development. *Myriophyllum spicatum* was the dominant submergent plant along the lake shoreline. Submergent vegetation coverage extended to a depth of one meter.

Shadow Lake's aquatic plants were surveyed for four of the five consecutive years between 1976 through 1980 (Metro, 1976; 1978; 1979; and 1980). In 1978, *M. spicatum* was found along the north shore of the lake. The historical submergent coverage has been light in density. Floating plant coverage has historically been less than one acre which is consistent with current coverage estimates.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Eleocharis sp.	El	Najas flexilis	Nf
Elodea canadensis	Ec	Nymphaea odorata	No
Equisetum sp.	Es	Potamogeton pusillus	Pb
Iris pseudacorus	Ip	Potentilla palustris	Pp
Juncus sp.	Ju	Spiraea douglasii	Sd
Myriophyllum spicatum	Ms	Typha latifolia	Tl

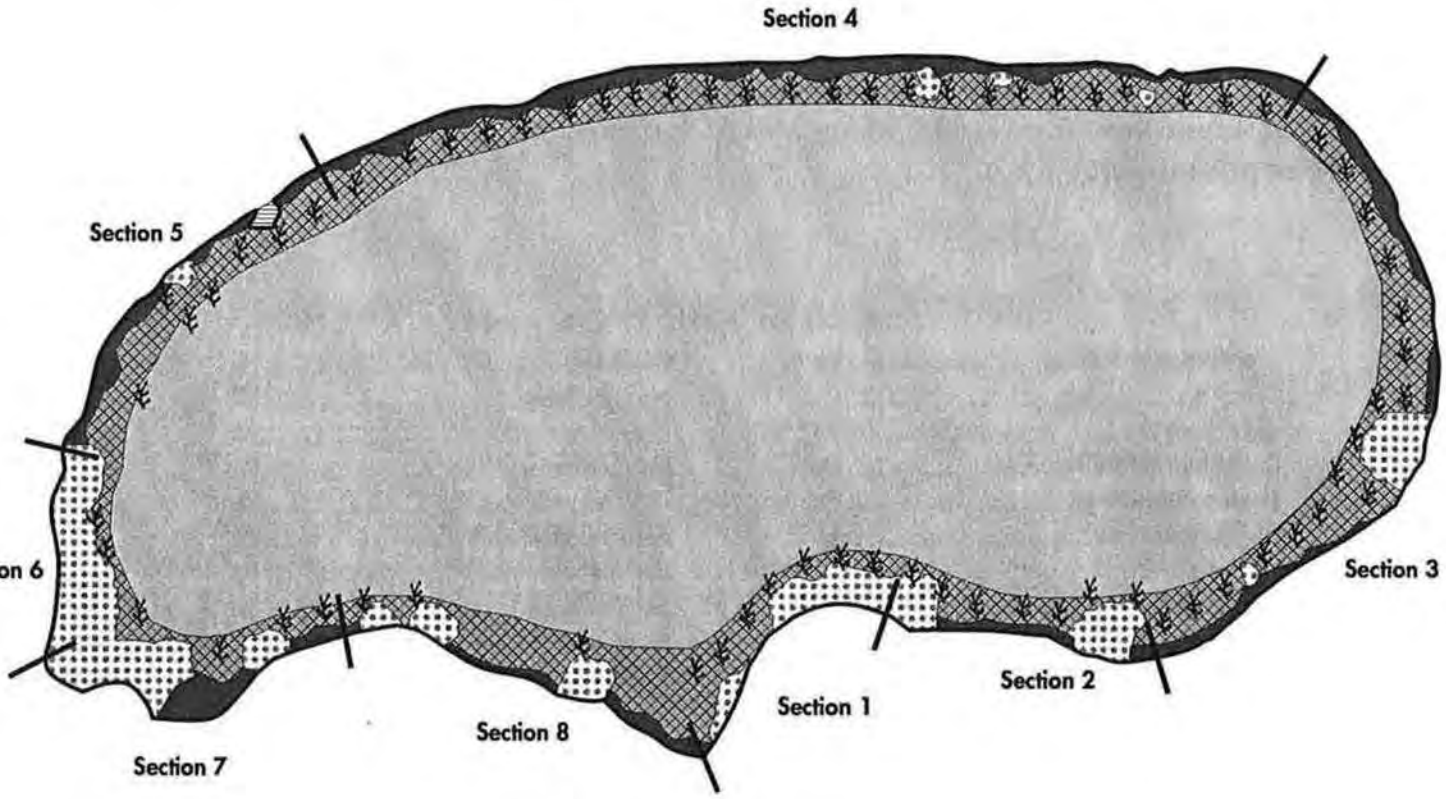
SPECIES PRESENT IN EACH SECTION

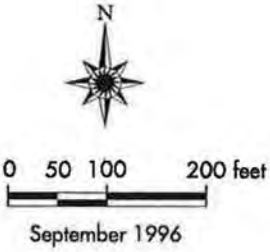
1 ..... Sd, Es, No, Ms	5 ..... Ju, Tl, Sd, Ms
2 ..... Tl, Pp, Ju, No, Ms, Ec	6 ..... Tl, Sd, Ip, Ju, Pp, No, Ms, Nf
3 ..... Tl, Sd, Es, No, Ms, Pb, Ec	7 ..... Tl, Sd, Ju, Pp, No, Ms
4 ..... No, Ms	8 ..... Tl, Sd, Ju, Pp, No, Ms

Shady

Aquatic Plants Map

- Floating
- Emergent
- Submergent
- No plants or sparse
- No plants—deep
- Milfoil
- Shoreline
- Section boundary





Lake Area: *18.8 acres*
Mean Depth: *21 feet*
Maximum Depth: *40 feet*

Spring

Spring Lake was surveyed on July 22, 1994. Secchi depth was 3.5 meters. Sky conditions were sunny. Twenty-six plant species (listed below) were identified including thirteen emergent types, four floating types, and nine submergent types. The floating plant coverage totaled 2.1 acres while the submergent community comprised 13.8 acres. Percent cover was variable throughout the lake for the floating and submergent communities. Plant coverage was greatest along the southwestern portion of the lake where a large wetland abuts the lake edge. *Myriophyllum spicatum* was found in the northern end of the lake only. Several patches of *Lythrum salicaria* were also found along the shoreline.

Spring Lake's aquatic plants were surveyed for four of the five consecutive years between 1976 through 1980 (Metro, 1976; 1977, 1978; and 1980). *M. spicatum* has been in the lake since before 1976 and herbicides had been used to control *M. spicatum* in the lake. In 1976, the dominant plants in the lake included *Brasenia schreberi, Nitella sp.*, and *Nymphaeae odorata*. By 1980, after several intervening herbicide applications *Elodea canadensis, Najas flexilis*, and *Potamogeton pusillus* were the dominant submergent plants present in the lake. Based on the 1994 SWM survey, these three species, along with *M. spicatum*, comprise the majority of the submergent plant community.

SPECIES PRESENT AND THEIR ABBREVIATIONS

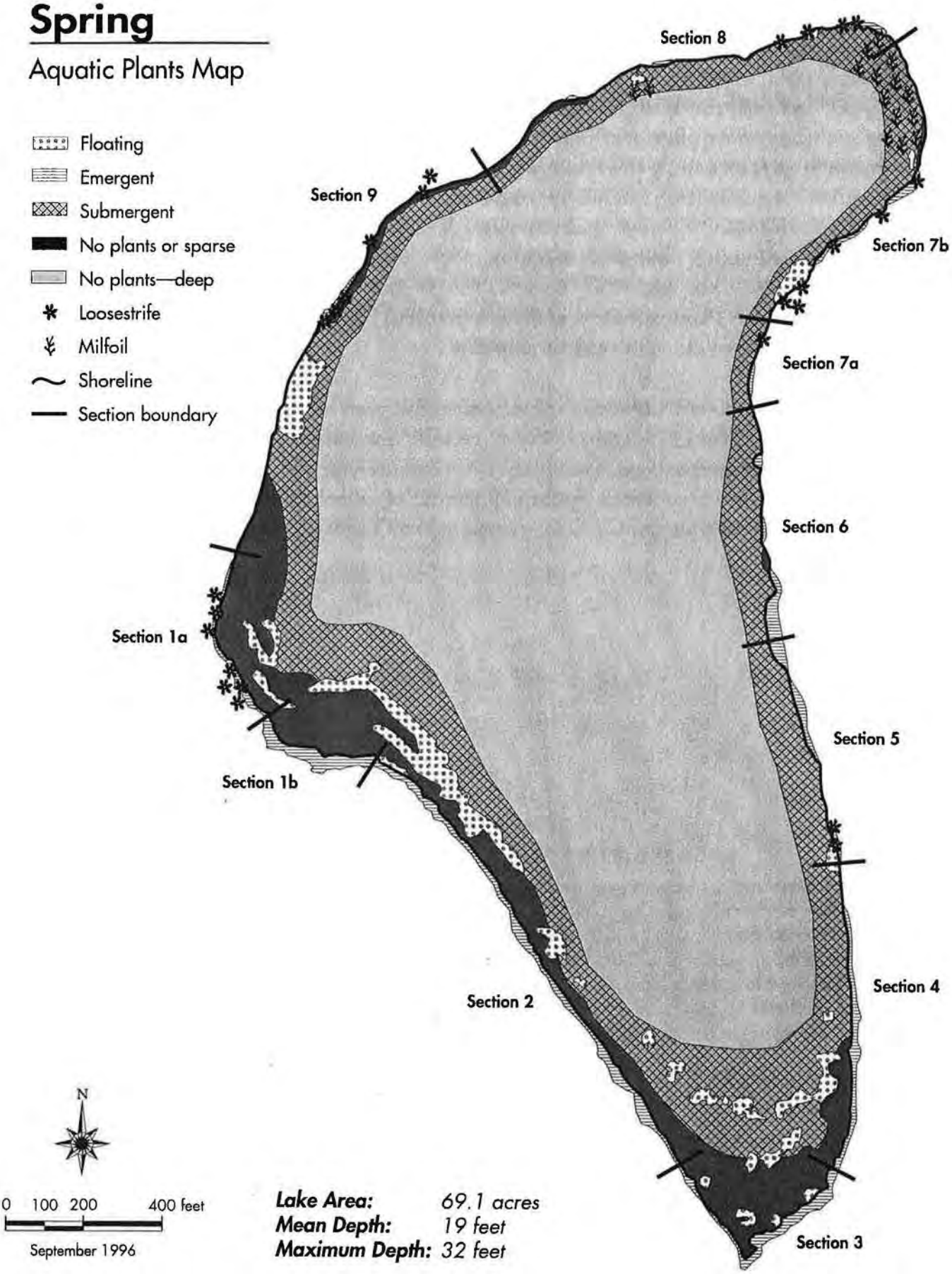
Brasenia schreberi	Bs	Nitella sp.	Ni
Carex sp.	Ca	Nuphar lutea	Nl
Chara sp.	Cs	Nymphaea odorata	No
Dulichium arundinaceum	Da	Polygonum sp.	Pm
Elodea canadensis	Ec	Potamogeton pusillus	Pb
Iris pseudacorus	Ip	Potamogeton epihydrus	Pe
Isoetes sp.	Is	Potentilla palustris	Pp
Juncus sp.	Ju	Sagittaria sp.	Sa
Ledum groenlandicum	Lg	Spiraea douglasii	Sd
Ludwigia palustris	Lp	Spirodela polyrhiza	Sp
Lythrum salicaria	Ls	Typha angustifolia	Ta
Myriophyllum spicatum	Ms	Typha latifolia	Tl
Najas flexilis	Nf	Utricularia sp.	Us

SPECIES PRESENT IN EACH SECTION

1a ..... Sd, Ip, Tl, Sa, Ls, Nl, Bs, Us, Ec, Nf, Pe	6 ..... Tl, Sd, Is, Ip, Ec, Pb, Ni, Pm, Pp, Lp
1b ..... Ju, Sd, Tl	7a ..... Ls, Ip, Tl
2 ..... Tl, Sd, Sp, Ju, Bs, Nl, Nf, Us, Ec, Ca, Da, Lg	7b ..... Tl, Sd, Ip, Ls, Ms, Ec, Nf, Ni, Pb, Pe
3 ..... Tl, Sd, Ip, Nl, Bs, No, Ec, Pb, Nf	8 ..... Ju, Tl, Sd, Nl, No, Pb, Ec, Ms, Ni
4 ..... Tl, Sd, Nl, Ec, Pe, Nf, Ni, Pb, Ta	9 ..... Is, Ls, Tl, Ip, No, Ec, Ms, Nf
5 ..... Tl, Sd, Ls, Nl, Pm, Pp, Lp	

Spring

Aquatic Plants Map



Lake Area: *69.1 acres*
Mean Depth: *19 feet*
Maximum Depth: *32 feet*

Star

Star Lake was surveyed on August 5, 1994. Secchi depth was 5.0 meters. Sky conditions were sunny. Fourteen plant species (listed below) were identified including five emergent types, two floating types, and seven submergent types. The floating plant coverage totaled 1.7 acres while the submergent community comprised 7.7 acres. Percent cover was typically greater than 75 percent for the floating community where present and less than 25 percent for the submergent community. Emergent vegetation coverage was very limited due to extensive shoreline development. During the 1994 survey, *Myriophyllum spicatum* was found only in the western cove of the lake. Plant collection at the lake during 1996 by SWM staff revealed that *M. spicatum* had spread to the entire eastern shoreline.

Star Lake's aquatic plants were surveyed for five consecutive years between 1976 through 1980 (Metro, 1976; 1977; 1978; 1979; and 1980). *M. spicatum* dominated the submergent community based on these previous surveys. During the five year survey period, expansion of areal coverage of *M. spicatum* was observed. Sparse populations of other submergents including *Elodea canadensis, Potamogeton sp., Chara sp., Nitella sp.*, and *Najas flexilis* were identified in previous surveys.

SPECIES PRESENT AND THEIR ABBREVIATIONS

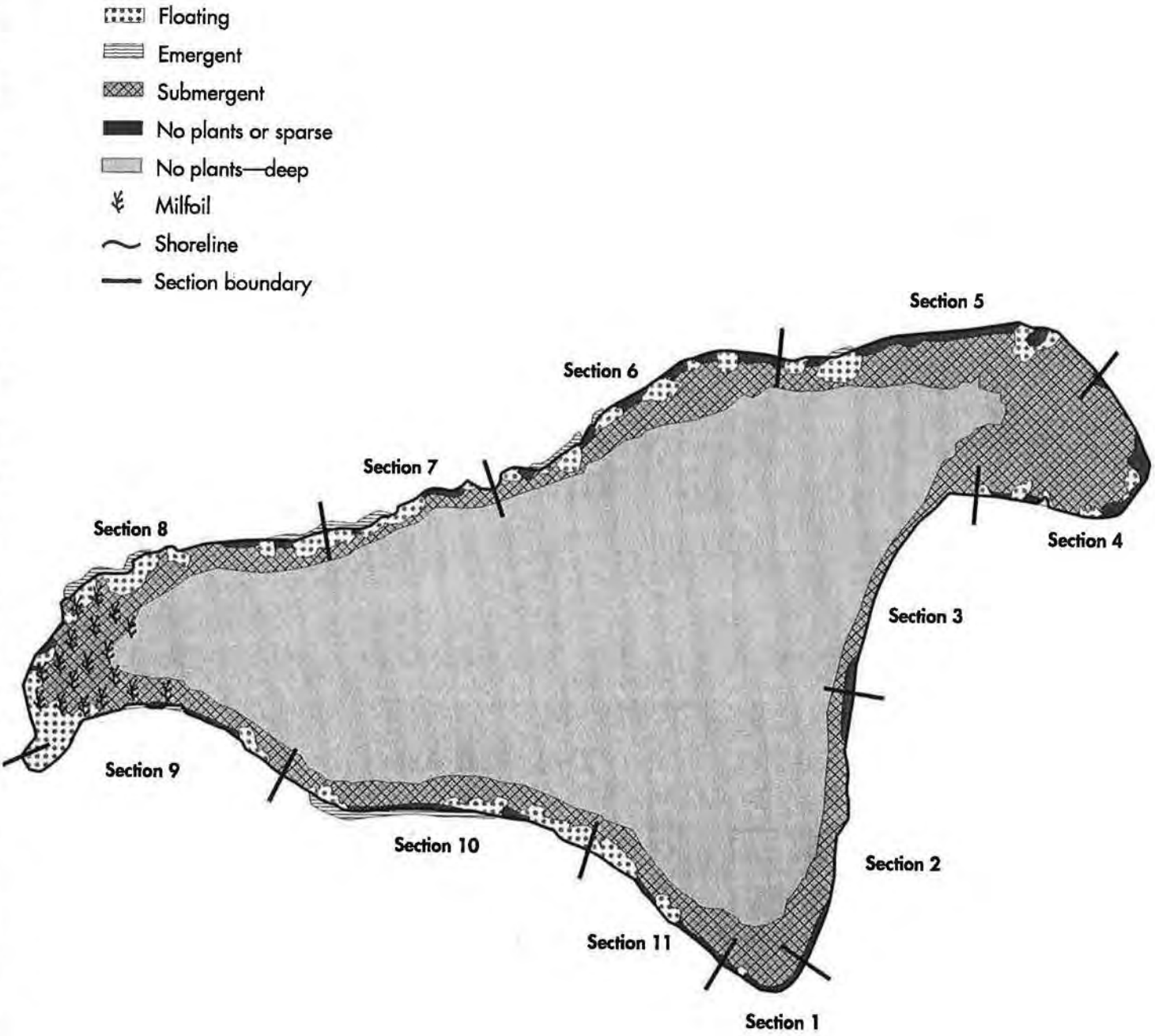
Chara sp.	Cs	Nuphar lutea	Nl
Elodea canadensis	Ec	Nymphaea odorata	No
Iris pseudacorus	Ip	Potamogeton amplifolius	Pa
Juncus sp.	Ju	Potamogeton pusillus	Pb
Myriophyllum spicatum	Ms	Sagittaria sp.	Sa
Najas flexilis	Nf	Spiraea douglasii	Sd
Nitella sp.	Ni	Typha latifolia	Tl

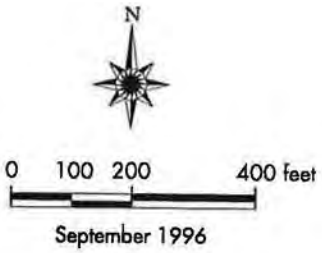
SPECIES PRESENT IN EACH SECTION

1 ..... Ip, No, Nf	7 ..... Sd, Ip, Ju, Nl, No
2 ..... Ip, Ju, Sa, Sd, Nf, Cs	8 ..... Ip, Ju, Nl
3 ..... No	9 ..... Ip, Nl, No, Ec, Ms, Pb, Ni, Nf
4 ..... Tl, Ju, Ip, Nl, No, Pa	10 ..... Ip, Sd, Ju, Nl, No, Pb
5 ..... Tl, Ip, Sd, Ju, No, Nl,	11 ..... Ip, No
6 ..... Ju, Ip, Tl, No, Nl	

Star

Aquatic Plants Map





Lake Area: *33.4 acres*
Mean Depth: *25 feet*
Maximum Depth: *50 feet*

Trout

Trout Lake was surveyed on August 11, 1994. Secchi depth was 2.0 meters. The survey team was assisted by Trout Lake resident Carl Spane during the survey. The weather was sunny during the survey. Eighteen plant species (listed below) were identified including ten emergent types, three floating types, and five submergent types. The floating plant coverage totaled 1.7 acres while the submergent community comprised 2.9 acres. In most sections, percent cover was typically between 25 and 75 percent or greater than 75 percent in coverage. Emergent vegetation coverage was partially limited by shoreline development.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Brasenia schreberi	Bs	Nitella sp.	Ni
Carex sp.	Ca	Nuphar lutea	Nl
Ceratophyllum demersum	Cd	Nymphaea odorata	No
Elodea canadensis	Ec	Potamogeton epihydrus	Pe
Iris pseudacorus	Ip	Potentilla palustris	Pp
Juncus sp.	Ju	Sagittaria sp.	Sa
Ledum groenlandicum	Lg	Spiraea douglasii	Sd
Ludwigia palustris	Lp	Typha latifolia	Tl
Najas flexilis	Nf	Utricularia sp.	Us

SPECIES PRESENT IN EACH SECTION

1 ..... Tl, Pp, Ip, Ju, No, Nl, Bs, Pe, Cd, Ec, Us

2 ..... Tl, Ca, Ju, No, Nl, Bs, Pe, Cd, Ec, Us, Lp

3 ..... Tl, Ju, Ip, Sd, Sa, No, Nl, Bs, Us, Lp, Ni

Channel .. Pe, Cd, Us, Ec, Ni

4 ..... Sa, Sd, Tl, Pp, No, Nl, Us, Ec, Nf, Ni, Lg

5 ..... Sa, Sd, Ip, Ju, Ca, Tl, Nl, Bs, No, Cd, Pe, Cd, Ec, Us

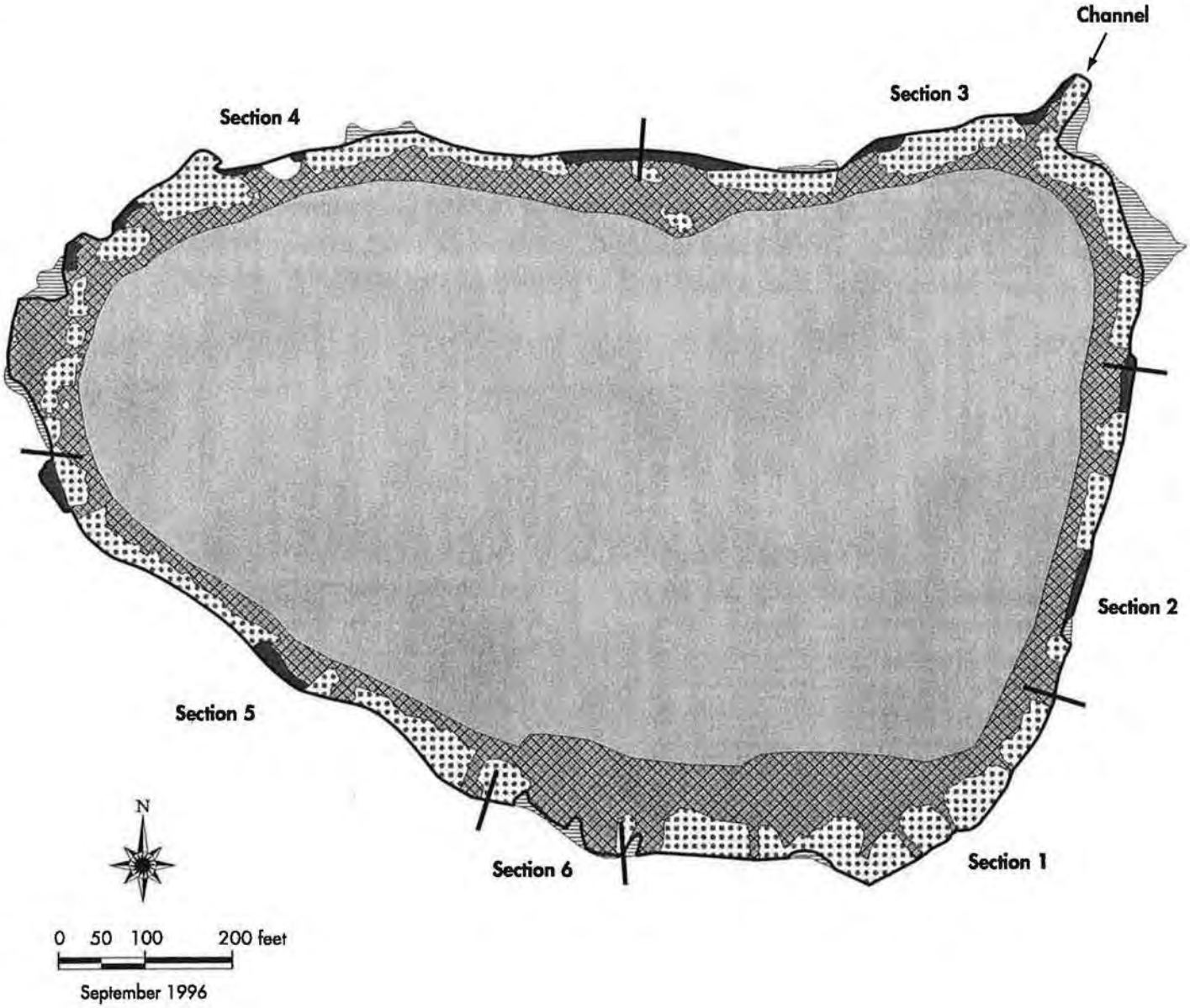
6 ..... Tl, Ip, No, Nl, Pe, Cd, Ec, Us

Trout

Aquatic Plants Map

- Floating
- Emergent
- Submergent
- No plants or sparse
- No plants—deep
- Shoreline
- Section boundary

Lake Area: *19.2 acres*
Mean Depth: *17 feet*
Maximum Depth: *27 feet*



Twelve

Lake Twelve was surveyed on July 20, 1995. Secchi depth was 2.1 meters. The survey team was assisted by Janice Dugen. Sky conditions were sunny. Eighteen plant species (listed below) were identified including nine emergent types, three floating types, and six submergent types. The floating plant coverage totaled 11.6 acres while the submergent community comprised 7.6 acres. Percent cover was typically between 25 and 75 percent for the floating and submergent communities. Wetland vegetation dominates the eastern end of the lake with the shoreline moderately developed for residential uses.

Lake Twelve's aquatic plants were surveyed for five consecutive years between 1976 through 1980 (Metro, 1976; 1977; 1978; 1979; and 1980). *M. spicatum* and *Nymphaea odorata* were the dominant plants based on previous surveys. Herbicides were reportedly used on the lake in 1976.

An integrated aquatic plant management plan (IAPMP) was competed in 1995 to address excessive growth of *M. spicatum* and *N. odorata* which in combination had significantly reduced recreational use of the lake. During 1996, the first year of IAPMP implementation will occur which includes fluridone application to eradicate *M. spicatum.* In 1997, as the next step in IAPMP implementation, glyphosate will be used to remove selected areas of *N. odorata.*

SPECIES PRESENT AND THEIR ABBREVIATIONS

Angelica sp.	As	Myriophyllum spicatum	Ms
Brasenia schreberi	Bs	Najas flexilis	Nf
Chara sp.	Cs	Nuphar lutea	Nl
Eleocharis sp.	El	Nymphaea odorata	No
Elodea canadensis	Ec	Phalaris arundinacea	Pd
Iris pseudacorus	Ip	Potamogeton amplifolius	Pa
Juncus sp.	Ju	Spiraea douglasii	Sd
Ludwigia palustris	Lp	Typha latifolia	Tl
Menyanthes trifoliata	Mt	Utricularia minor	Um

SPECIES PRESENT IN EACH SECTION

1 ..... Sd, Lp, Ip, Ju, As, Pd, Nl, Bs, No, Ms, Um, Mt

2 ..... Sd, Lp, Pd, Ip, Nl, No, Bs, Ms, Pa

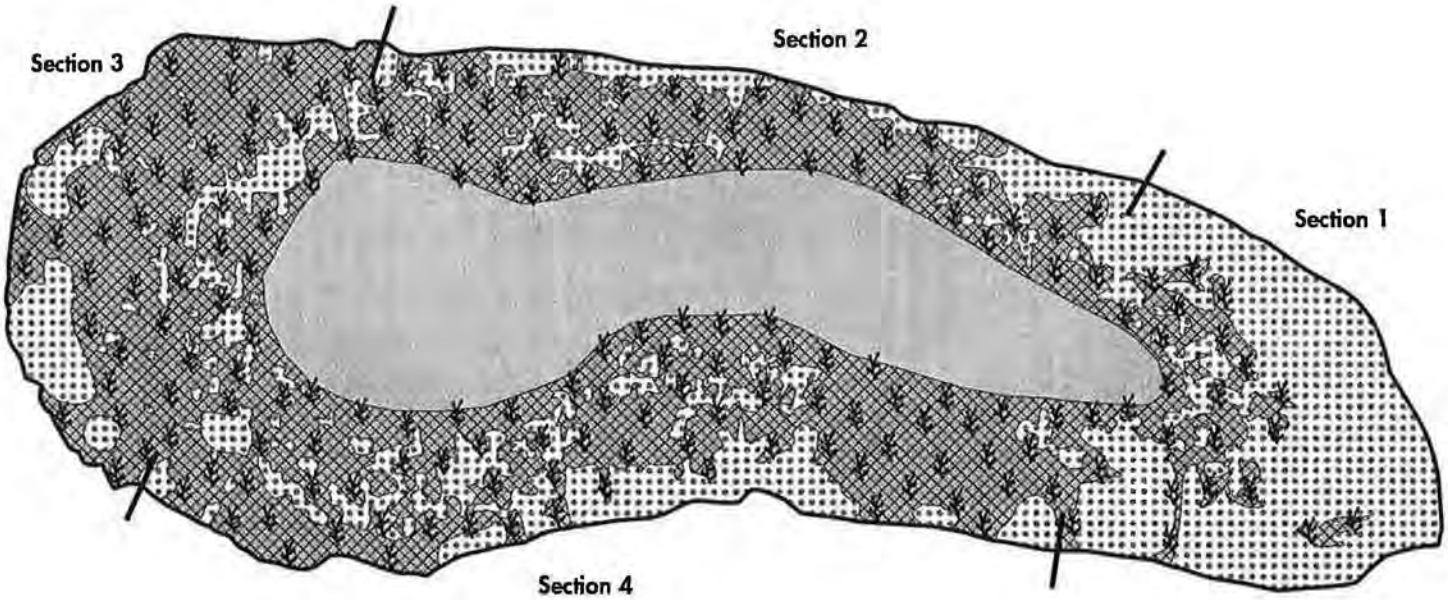
3 ..... Sd, Lp, Pd, Ip, Nl, No, Bs, Ms, Um, Pa

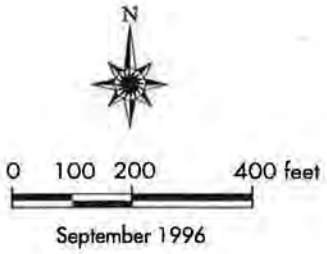
4 ..... Sd, Lp, Pd, Ip, Nl, No, Bs, Ms, Um, Pa

Twelve

Aquatic Plants Map

- Floating
- Emergent
- Submergent
- No plants or sparse
- No plants—deep
- Milfoil
- Shoreline
- Section boundary





Lake Area: *38.8 acres*
Mean Depth: *13 feet*
Maximum Depth: *28 feet*

Walker

Lake Walker was surveyed on August 23, 1995. Secchi depth was 5.5 meters with good water clarity. The weather was overcast during the survey. Nine plant species (listed below) were identified including six emergent types, one floating type, and two submergent types. The floating plant coverage totaled 0.01 acres while the submergent community comprised 0.5 acres. Plant coverage was very sparse and was less than 25 percent throughout the lake. The shoreline was moderately developed for residential uses.

SPECIES PRESENT AND THEIR ABBREVIATIONS

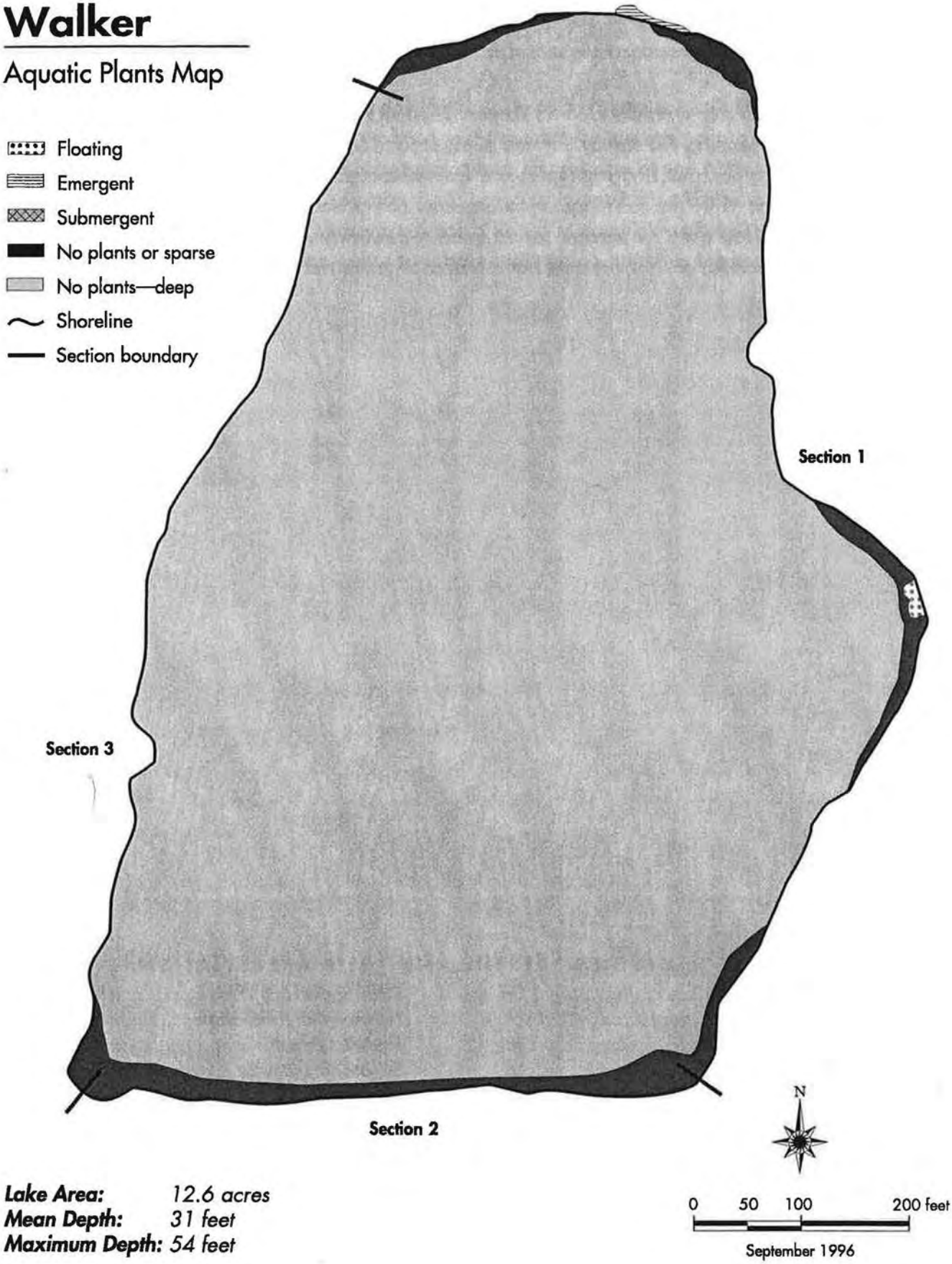
Eleocharis sp.	El	Nuphar lutea	Nl
Elodea canadensis	Ec	Potentilla palustris	Pp
Iris pseudacorus	Ip	Scirpus sp.	Sb
Juncus sp.	Ju	Spiraea douglasii	Sd
Nitella sp.	Ni		

SPECIES PRESENT IN EACH SECTION

1 ..... Ip, Ju, Pp, Ec, Ni	3 ..... Ip, Sd, Ec
2 ..... Pp, Sd, Ju, Nl, Ec	

Walker

Aquatic Plants Map



Lake Area: *12.6 acres*
Mean Depth: *31 feet*
Maximum Depth: *54 feet*

Welcome

Welcome Lake was surveyed on August 15, 1995. Secchi depth was 1.8 meters. The weather was cloudy during the survey. Fifteen plant species (listed below) were identified including nine emergent types, one floating types, and five submergent types. The floating plant coverage totaled 0.1 acres while the submergent community comprised 3.4 acres. Plant coverage was very sparse and was less than 25 percent for all three community types in both sections. The shoreline is developed for residential uses but a buffer of terrestrial vegetation exists along most of the shoreline.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Carex sp.	Ca	Potamogeton epihydrus	Pe
Eleocharis sp.	El	Potamogeton richardsonii	Pi
Juncus sp.	Ju	Potentilla palustris	Pp
Ludwigia palustris	Lp	Scirpus sp.	Sb
Nuphar lutea	Nl	Sparganium sp.	Sf
Polygonum sp.	Pm	Spiraea douglasii	Sd
Potamogeton alpinus	Pl	Utricularia vulgaris	Uv
Potamogeton pusillus	Pb		

SPECIES PRESENT IN EACH SECTION

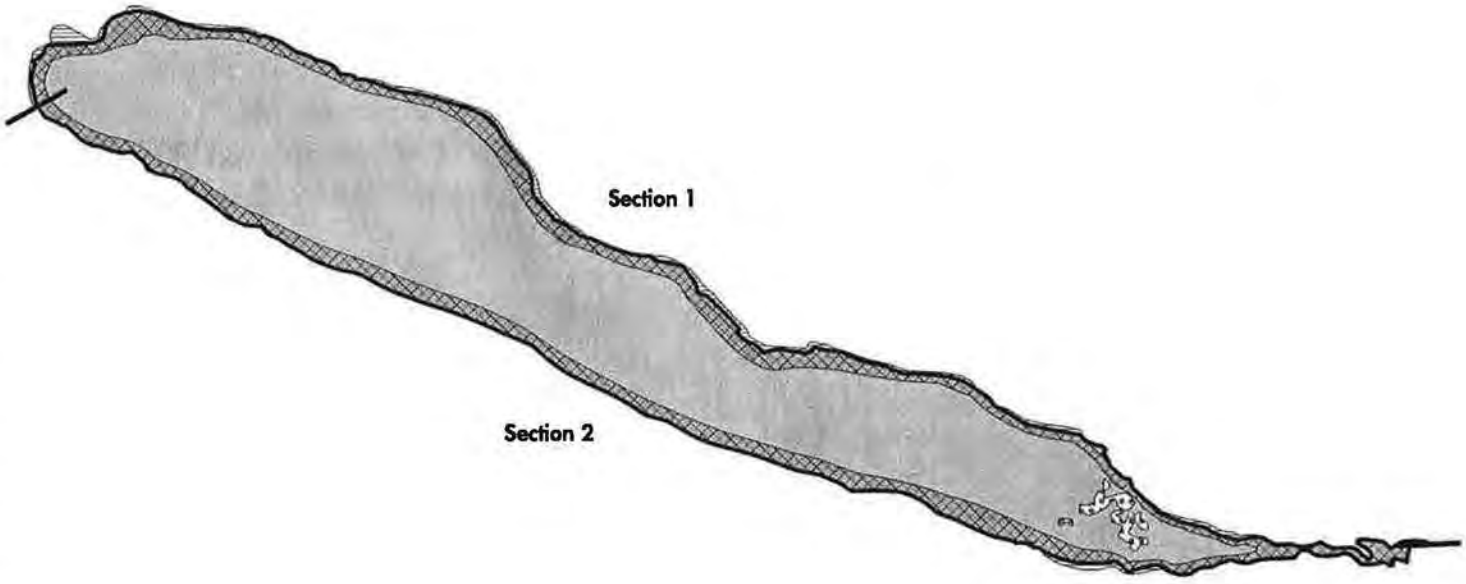
1 ..... Sd, Ca, Ju, Lp, Pp, Nl, Uv, Pb, Pi, Pe

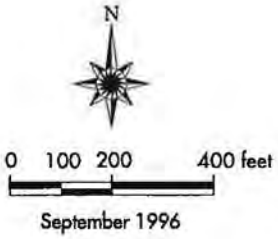
2 ..... Lp, Ca, Sd, Ju, Nl, Uv, Pb

Welcome

Aquatic Plants Map

- Floating
- Emergent
- Submergent
- No plants or sparse
- No plants—deep
- Shoreline
- Section boundary





Lake Area: *15.3 acres*
Mean Depth: *Data not available*
Maximum Depth: *Data not available*

Wilderness

Lake Wilderness was surveyed on August 8, 1994. The survey team was assisted by Lake Wilderness resident Pat Anderson. Secchi depth was 2.3 meters. Sky conditions were sunny. Thirteen plant species (listed below) were identified including five emergent types, one floating type, and seven submergent types. The floating plant coverage was very small totaling only 0.2 acres while the submergent community comprised the majority of the aquatic plant coverage at 19.5 acres. In sections 1, 2, and 4, percent cover of the submergent community was between 25 and 75 percent, while in section 3, coverage was less than 25 percent. Emergent and native vegetation still dominates the northern and eastern shoreline areas of the lake which are owned by King County Parks.

The Lake Wilderness aquatic plant community was last surveyed between 1976 and 1980 (Metro, 1976; 1978; and 1980). In 1976, *Potamogeton pusillus* and *Elodea canadensis* were noted as the dominant plants in the lake. During the 1980 survey, *Potamogeton pusillus, Elodea canadensis,* and *Najas flexilis* were the dominant species noted.

The submergent community now includes *Myriophyllum spicatum* which was introduced into the lake sometime after the 1980 survey. In 1996, the SWM Division will work with the Lake Wilderness Protection Association to develop an integrated aquatic plant management plan to address the removal of *M. spicatum* which now dominates much of the submergent plant community and has impacted recreational uses of the lake. Dense growths of *M. spicatum* can be found in the north end of the lake and around the swimming beach maintained by King County Parks. The aquatic plant management plan will be completed in 1997.

SPECIES PRESENT AND THEIR ABBREVIATIONS

Elodea canadensis	Ec	Potamogeton pusillus	Pb
Iris pseudacorus	Ip	Potamogeton epihydrus	Pe
Juncus sp.	Ju	Potamogeton richardsonii	Pi
Myriophyllum spicatum	Ms	Scirpus sp.	Sb
Najas flexilis	Nf	Spiraea douglasii	Sd
Nitella sp.	Ni	Typha latifolia	Tl
Nymphaea odorata	No		

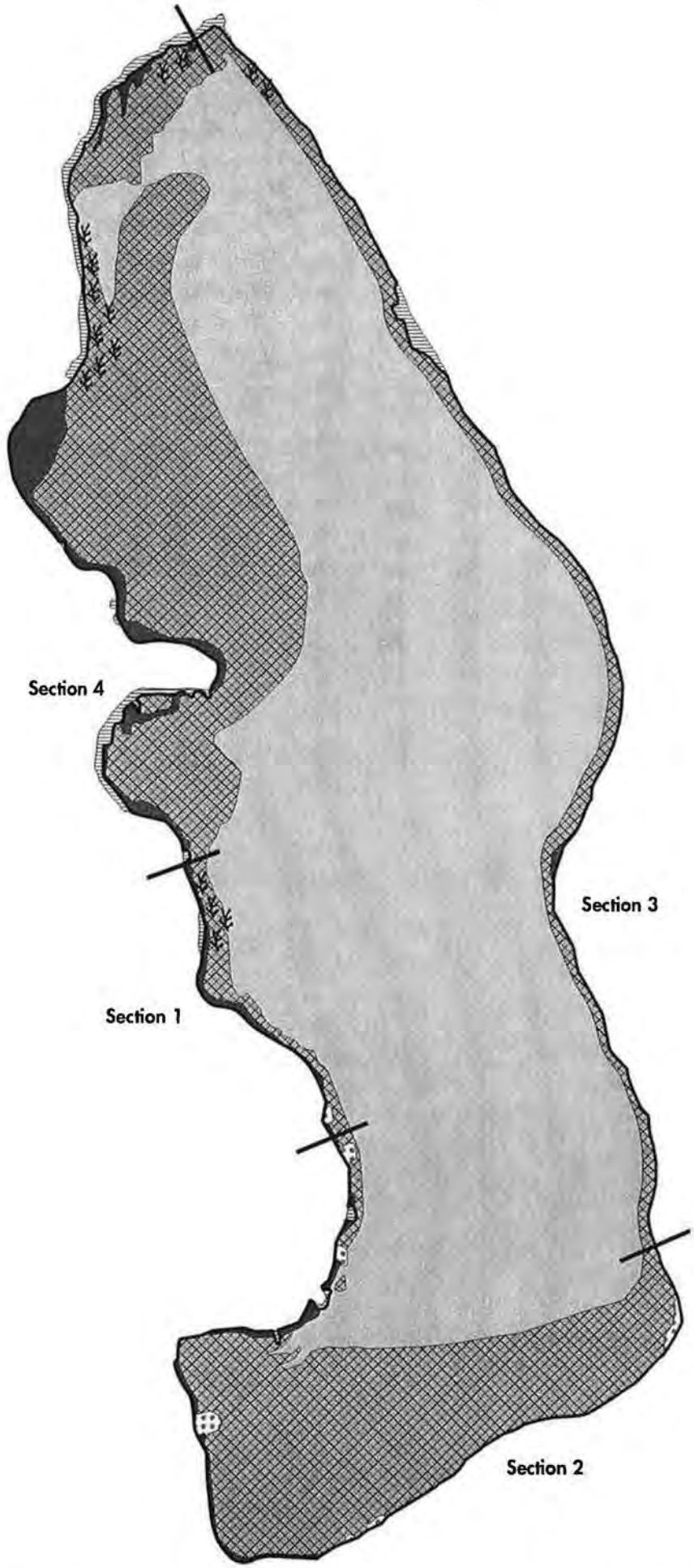
SPECIES PRESENT IN EACH SECTION

1 ..... Ip, Ju, Sd, Pe, Ec, Pb, Nf, Pi, Ms	3 ..... Ip, Sd, Pe, Ec, Pb, Ms
2 ..... Tl, Ip, No, Pe, Ec, Pi, Ni, Ms, Ip, Sd	4 ..... Ip, Sd, Pe, Ec, Ms, Ni, Pi

Wilderness

Aquatic Plants Map

- Floating
- Emergent
- Submergent
- No plants or sparse
- No plants—deep
- Milfoil
- Shoreline
- Section boundary

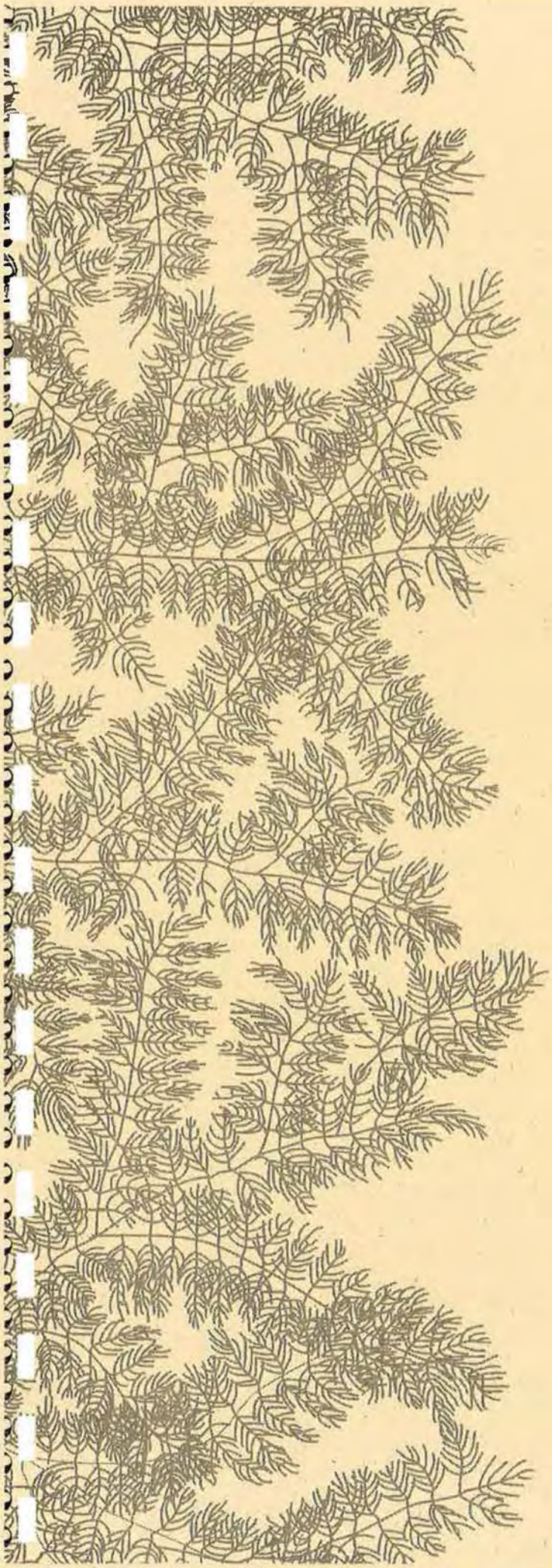


Lake Area: *56.9 acres*
Mean Depth: *21 feet*
Maximum Depth: *38 feet*

N

0 100 200 400 feet

September 1996



Chapter 4

Discussion & Recommendations

Chapter 4: Discussion and Recommendations

AQUATIC PLANT MANAGEMENT IN KING COUNTY

Lake Stewardship Program

King County provides technical assistance (e.g., lake management district formation, water quality, aquatic plants, and grant sponsorship), public involvement and education (e.g., workshops, newsletter, fact sheets, booklets, and guidebooks), and volunteer monitoring (e.g., physical and biological) support to lake communities in unincorporated areas through the SWM Division's Lake Stewardship Program. The technical assistance component of the program includes aquatic plant identification, mapping, and management activities. The primary goals for the program's aquatic plant management elements include:

- Education of the public regarding the beneficial uses of aquatic plants;
- Prevention and/or eradication of noxious aquatic weeds, including annual purple loosestife pulling events;
- Sponsorship of grants for integrated aquatic plant management for lakes with aquatic plant problems;
- Promotion of the use of small-scale aquatic plant removal techniques to provide reasonable access to open water areas of the lake;
- Evaluation of new or experimental aquatic plant control methods for use in Washington lakes; and
- Implementation of integrated aquatic plant management plan recommendations.

Existing Regulatory Framework

In the current King County Code, lake and shoreline management activities have not been clearly differentiated from wetland management activities. For regulatory purposes, wetlands have been defined in the code but no lake specific definition exists. Technically, many lakes (and their adjacent shorelines) are classified as lacustrine or open-water wetland systems. Since the early 1990s, most lakes have been regulated through this wetland classification system for zoning, land use management, and development purposes. Prior to the creation of King County wetland regulations in 1990, the Shoreline Management Act of 1971 and associated master program were

the regulatory guidelines used to permit shoreline development and management activities.

Most lakes differ substantially from wetlands in their uses. Lakes are utilized by humans for a variety of benefits including swimming, fishing, boating, aesthetics, and water supply. Lakes, like wetlands environments, also provide significant aquatic habitat value. Historically, as evidenced by (1) development patterns, (2) public perception, and (3) geographic naming, lake shorelines have been developed for both private (homes) and public (preserves, parks, and boating ramps) uses. This same level of anthropogenic use (except for agricultural purposes) has not been characteristic around wetlands and their buffers in King County.

For lakes classified as wetlands, the King County Shoreline Management, Grading, and Zoning (including the Sensitive Areas ordinance) codes limit aquatic plant management activities to noxious weed removal. More complex aquatic plant management issues including: (1) removal of non-native water lilies; (2) implementation of integrated aquatic plant management plan recommendations; or (3) the testing and evaluation of new aquatic plant control techniques are severely hindered. The combination of codes can make aquatic plant management illegal (depending upon the interpretation of the proposed aquatic plant management activity), or at best, expensive and time consuming due to additional permitting, review, and associated costs required by King County's code enforcement agency.

By examining the available definitions for both lakes and wetlands, it is apparent that some distinction between these aquatic resource systems is present both ecologically and anthropogenically. According to Title 21A.06.1415 of the King County Zoning Code (King County, 1993 and King County, 1995), wetlands are defined as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Since no definition of a lake exists in the current King County Code, the approaches of other agencies and professional lake organizations were explored (King County, 1995). Based on a combination of the approaches used by others, a lake could be defined as "a standing body of freshwater in a depression of land or expanded part of a river, including reservoirs, that has recreational value, exhibits no oceanic or tidal influences, has a total dissolved solids concentration of less than 1 percent, and is 20 acres or greater in total area, with a maximum depth of at least 2 meters" (King County, 1995).

Setting the size criteria at 20 acres (Shoreline Management Act of 1971) in this definition would exclude approximately half of the lakes in the SWM service area. Using a smaller size criteria (i.e., 10 or 15 acres), and emphasizing the recreational value in a lake definition, would most likely better serve lake residents pursuing aquatic plant management activities as well as clarify the existing regulatory framework for other lake shoreline related activities.

Current Problems with Aquatic Plants

In part due to the heavy use of lakes by humans, aquatic plants have become a nuisance through lake eutrophication (via the addition of sediment through erosion and nutrients from fertilizers, animal waste, and failing septic systems) or through the introduction of ornamental plants or noxious weeds. In some instances, native plant populations can also be viewed by residents as a nuisance if the plants cover large areas of the lake shoreline or lake surface and interfere with the recreational uses of the lake.

Shoreline residents are frustrated with the lack of management tools available to them to more efficiently and legally address aquatic plant problems along their shoreline. Over the last several years , the SWM Division's Lake Stewardship Program has worked with both individual property owners and homeowner associations to provide information regarding the benefits of aquatic plants as well as explain the relatively limited options available for small scale plant removal. The lack of simple aquatic plant management tools for lake residents often results in the illegal use of bottom barriers, herbicides, mechanical methods, or other improvised methods to remove unwanted plants. Aquatic plant management goals which try to strike a balance between aquatic habitat and human uses increasingly are not met under this scenario.

An evaluation of the regulatory mechanisms which currently impede or restrict the pursuit of balance management goals would provide the opportunity to assess lakes and their regulation as a separate sensitive area category. Placing lakes in a separate sensitive area category and defining appropriate aquatic plant management activities for lakes would help to reduce the current conflicts present in the County code and reduce residents' frustration with limited management options. More importantly, the protection and preservation activities which are appropriate to lakes could be clearly defined, allowing the goals of resource protection to be better met by agencies, lake groups, and individual residents alike.

Aquatic Plant Management Activities on Surveyed Lakes

To evaluate where aquatic plant management activities have taken place in King County, several data sources must be accessed and reviewed. These sources include King County Shorelines Exemptions or permits, Washington State Department of Ecology (WSDOE) Water Quality Modification permits, Washington State

Table 5: Water Quality Modification Requests for 1992-1996.

Lake	Request Year	Herbicide
Geneva	1992/93/94/95	Rodeo©
Killarney	1992/93/94/96	Copper Sulfate, Sonar©
Lucerne	1995/96	Sonar©
Meridian	1993/1994/95	Rodeo©
Pipe	1995/96	Sonar©
Twelve	1995/96	Sonar©
Wilderness	1994	Rodeo©

Department of Agriculture spray reports, and Washington Department of Fish and Wildlife (WDFW) Hydraulic Project Approval permits. Most of the data sources related to aquatic plant management activities exist in files which are not easily queried unless specific details (i.e., lake name and data) regarding the management activity are known.

The most accessible data source is the WSDOE Water Quality Modification permit requests. Table 5 summarizes the recent permit requests which have been made to the WSDOE Northwest Regional Office (Kautz, personal communication, August 1996). Based on antidotal information and review of the water quality modification permit requests, most current aquatic plant management activities in King County have consisted of the placement of bottom barriers, the use of herbicides, or removal by hand.

Several King County lakes are completing or have completed integrated aquatic plant management plans (IAPMP). In 1995, an IAPMP was completed at Lake Twelve for *Myriophyllum spicatum* and *Nymphaea odorata* control. During 1996, Sonar© was applied to control *M. spicatum.* At lakes Killarney and Wilderness, IAPMPs are currently being developed to address long-term aquatic plant management needs. Lake Killarney is a very shallow lake (average depth is nine feet) which has had ongoing aquatic plant management activities performed at the request of the Lake Killarney Improvement Association (LKIA). These activities have included Sonar© applications for plant control and copper sulfate applications for algal control. During 1996, Sonar© was again applied at Lake Killarney at the request of the LKIA to control aquatic plant growth.

At Lake Wilderness, rapid growth and spread of *M. spicatum* is the primary aquatic plant management concern. The lake has a large regional park facility with a swimming beach area which is impacted by excessive growth of *M. spicatum.* Currently, an IAPMP is being developed for Lake Wilderness to address long-term aquatic plant management needs associated with *M. spicatum.*

At lakes Lucerne and Pipe, *Hydrilla verticillata* was preliminarily identified in the lake in 1994. After confirming the presence of *H. verticillata* in 1995, Sonar© was applied in 1995 and again in 1996 to eradicate the plant from the lake. In 1997, ongoing diver surveys will be used to confirm the eradication of *H. verticillata.*

For many of the surveyed lakes, handpulling and handcutting techniques are being used to control aquatic plants by individual residents. Bottom barriers are another technique which individual homeowners are using to control aquatic plant growth and were commonly found on most of the surveyed lakes. Based on antidotal information, most of the bottom barriers have not been approved by the WDFW.

AQUATIC PLANT COMMUNITIES IN KING COUNTY LAKES

Based on the 1994-1995 aquatic plant survey and historical Metro surveys (Metro 1976, 1977, 1978, 1979, and 1980), most of the plant communities in King County lakes have been subjected to a some degree of disturbance. These disturbances range from localized shoreline impacts to the implementation of lake wide aquatic plant management techniques. Examples of the most common disturbances observed, discussed in past surveys, or provided antidotedly by residents, included herbicide use (legal and illegal), hand removal, dredging, shoreline development, bottom barriers, substrate additions (e.g., sand or gravel), and motorized boating.

It is clear from the review of past surveys and records, many of aquatic plant management actions are not well documented. Because this wide variety of disturbances exists for most lakes, it is increasingly difficult to develop correlations between community composition among lakes and the factors that may influence the presence or absence of individual species. However, disturbance is generally a contributing factor to the invasion and establishment of non-native species and appeared to be an important factor with the establishment of noxious emergent weeds (*Lythrum salicaria* and *Iris psuedacorus*). Motorized boating activity also appeared to be important in the spread of the noxious submergent species, *Myriophyllum spicatum.*

Sixty species of emergent, floating, or submergent species were observed during the 1994-1995 SWM survey. Only nine species occurred in 75 percent or more of the survey lakes. These species included *Elodea candensis, Iris psuedacorus, Juncus sp., Nitella sp., Nuphar lutea, Nymphaea odorata, Potamogeton pusillus, Potentilla palustris, Spiraea douglasii,* and *Typha latifolia.* Other commonly observed species (in 55 percent of the lakes or more) included *Chara sp, Ludwigia palustris, Najas flexilis, and Potamogeton amplifolius. Potamogeton sp.* represented the most diverse genera with 13 species identified during the survey.

Combined emergent, floating submergent species diversity for the 36 surveyed lakes ranged from nine to 29 species. Beaver lake was the most diverse with 29 species followed by Dolloff, Killarney, Ravensdale, Sawyer, Shadow, and Spring which had 20 or more total species. Since emergent vegetation presence was largely dependent on shoreline character, total species number for floating and submergent species only was also determined. For floating and submergent species only, diversity ranged from three to 17 species. Langlois, Morton, and Walker were the least diverse with only three species present while Beaver and Sawyer were the most diverse with 15 and 17 species, respectively.

Six lakes outside of the SWM service area (Alice, Bass, Deep, Langlois, Margaret, and Walker) were included in the survey to compare species composition of rural lakes with that of urban or urbanizing lakes which are generally found within the SWM service area. Species diversity was generally lower for the rural lakes ranging from three to eight floating or submergent species with lakes Alice, Langlois, and Walker ranking within the top four lakes overall. The lower species diversity may be due in part to the natural lake morphometry (e.g., deeper and steep sloped) and lower trophic status associated with most of these rural lakes.

NOXIOUS WEED DISTRIBUTION

Noxious weeds are generally non-native and invasive, resulting in the displacement of native species and the degradation of the habitat value of the affected areas. Of the 36 lakes which were surveyed as part of this project, 22 lakes had one or more state listed noxious weed (*Hydrilla verticillata, Lythrum salicaria, Myriophyllum spicatum,* and/or *Phalaris arundinacea*) present (Figure 5). Moreover, 70 percent of the public access lakes surveyed (18 of 26) and 38 percent of the lakes surveyed without public access (three of eight) had at least one noxious weed species present. Two of the six rural lakes (Alice and Bass) also had noxious weeds present. It appears that for these two rural lakes, remoteness or reduced human use did not preclude the establishment of non-native species.

As the lakes were surveyed for this project, general location information (see lake maps in Chapter 3) was determined for both *Myriophyllum spicatum* (Eurasian watermilfoil) and *Lythrum salicaria* (purple loosestrife), two noxious aquatic weeds known to be found in King County lakes. Both plants are Class B noxious weeds and are designated for control where they have not become widespread. Additionally, preventing new infestation is a high priority for Class B weeds. In areas where the plants are abundant, control is decided at the local level with containment as the primary management goal.

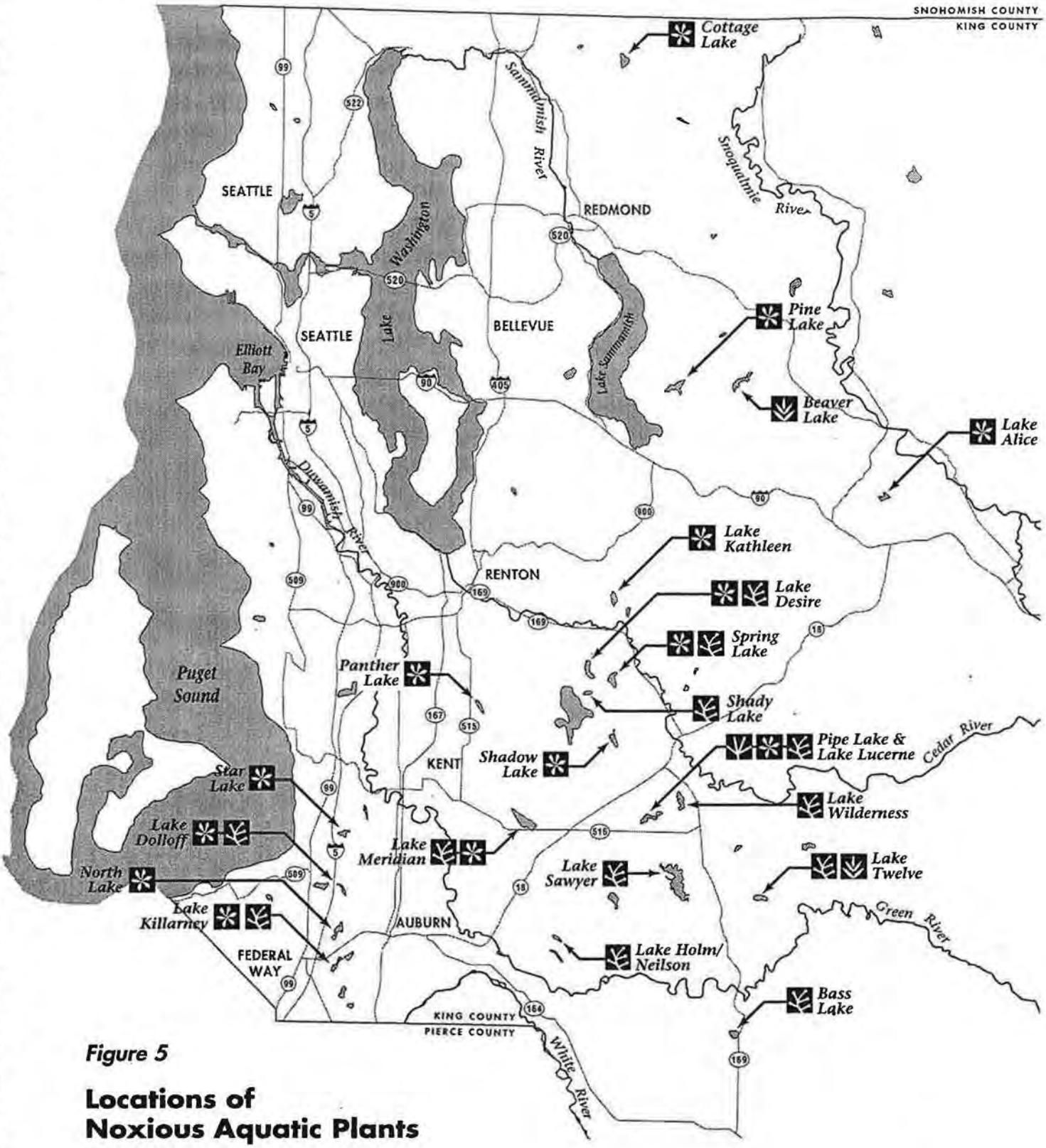


Figure 5

Locations of Noxious Aquatic Plants

Western King County

Lythrum salicaria (Purple Loosestrife)

Phalaris arundinacea (Reed Canary Grass)

Myriophyllum spicatum (Eurasian Watermilfoil)

Hydrilla verticillata (Hydrilla)

King County Surface Water Management
Everyone lives downstream

N

0 2 4 Miles

August 1996

During the first year of the SWM Division's aquatic plant mapping project, *Hydrilla verticillata* (hydrilla) was identified in lakes Lucerne and Pipe (see Lucerne/Pipe in Chapter 3 for the current status on eradication of hydrilla at these lakes). The finding of *H. verticillata* in these lakes represented the northern-most occurrence of the plant in North America and the first documentation of the plant in Washington. Subsequently, hydrilla was added to the list of noxious aquatic weeds present in King County and was listed as a Class A weed on the Washington State noxious weed list during 1995. Class A weeds are non-native species of limited distribution. Preventing new infestation and eradicating existing infestations is the primary management goal for Class A weeds.

The presence of the Class C noxious weed, *Phalaris arundinacea* (reed canary grass) was also recorded during the aquatic plant survey of lakes. Class C weeds are generally widespread in the state. Class C weed control is left to local authorities to prioritize for management depending upon the level of threat and feasibility for control.

Other non-native species which were documented during the survey but are not currently listed on the noxious weed list included *Iris pseudacorus* (yellow iris) and *Nymphaea odorota* (white and pink water lilies). Both of these species have invasive qualities, form monotypic stands, and can degrade surrounding aquatic habitat as they become established.

Myriophyllum spicatum (Eurasian Watermilfoil)

Myriophyllum spicatum is an invasive submergent non-native plant and can be found in water depths ranging from several feet to 15 feet. The leaves of *M. spicatum* are distinctly feather-like in appearance with twelve or more leaflet pairs along the main vein of the leaf. The leaflets are arranged in whorls of four along the plant stem. The lower portion of the plant is dominated mostly by the stem in deeper waters with leaf whorls spacing becoming closer at the top of the plant. As the plant reaches the water surface, it continues to grow prostrate, forming thick dense mats impeding boating, fishing, and swimming activities. The plant easily regrows from small fragments which are spread throughout the lake from boating, fishing, hand-removal, mechanical harvesting, and wave action.

Most accounts suggest that *M. spicatum* was first introduced into Washington in the mid-1970s. However, the University of Washington has a herbarium specimen from Lake Meridian (Kent, Washington) which documents its presence in King County as early as 1965 (J. Parson, personal communication, August 1996). During the 1994 and 1995 surveys, *M. spicatum* was identified in 15 of the 36 lakes surveyed. Table 6 summarizes the establishment information available for *M. spicatum* based on historical Metro surveys and the 1994 and 1995 surveys completed by the SWM Division. During the 1976 survey, *M. spicatum* was observed in lakes Bass, Green,

Meridian, Sawyer, Shadow, Spring, Star, and Twelve (Metro, 1976 and Metro, 1977). In Shady Lake and Lake Desire, *M. spicatum* was first noted in 1978 and 1979, respectively. Based on antidotal information, some of these lakes had some history of herbicide use to control *M. spicatum.*

Of the 19 lakes surveyed for this project and which were included in the original Metro surveys between 1976 and 1980, only Lucerne, Pipe, and Wilderness became infested between 1980 and 1994. Additionally, *M. spicatum* infestations have been identified by the SWM Division in lakes Dolloff, Killarney, and Neilson. These lakes did not have historical survey information available, so the timing of establishment of *M. spicatum* in these lakes is not known.

The level of *M. Spicatum* infestation in the surveyed lakes ranged from having just a few areas of the littoral zone impacted (low) to having the entire littoral zone impacted (high). Generally, there was no correlation between lake depth or clarity and the level of infestation. The mean depth of the affected lakes ranged from one to 12 meters while Secchi depth taken at the time of the survey ranged from two to six meters.

Table 6: Myriophyllum spicatum *Establishment in Fifteen Surveyed Lakes*

No.	Lake Name	Metro/SWM Survey* First Notation	Infestation Timeline	Infestation Level**	Past Herbicide Use
1	Bass	1976	prior to 1976	High	Unknown
2	Desire	1979	1978 or 1979	Low	Possibly
3	Dolloff	1994	unknown	Low	Unknown
4	Killarney	1995	mid 1980's	Low	Yes
5	Lucerne	1994	after 1980, before 1994	Medium	Yes
6	Meridian	1976#	prior to 1976	High	Yes
7	Neilson (Holm)	1994	unknown	Low	Unknown
8	Pipe	1994	after 1980, before 1994	Low	Yes
9	Sawyer	1976	prior to 1976	High	Yes
10	Shadow	1976	prior to 1976	Medium	Unknown
11	Shady	1978	1977 or 1978	High	Unknown
12	Spring	1976	prior to 1976	Low	Yes
13	Star	1976	prior to 1976	Low	Possibly
14	Twelve	1976	prior to 1976	High	Yes
15	Wilderness	1994	after 1980, before 1994	Medium	Possibly

** Data Source: Metro 1976, 1977, 1978, 1979, and 1980; SWM Division ºSurveys 1994 and 1995*

***High- plant established in entire littoral zone; Medium-approximately half of the littoral zone impacted; and Low-only a few areas of plant establishment in littoral zone*

 # A herbarium specimen from the University of Washington dates the presence of M. spicatum to 1965.

Two factors which may contribute to the level of infestation observed in the surveyed lakes include boating activity and historical use of herbicides. Lakes with motorized (primarily gas combustion) boating use, including lakes Bass, Meridian, and Sawyer, may have a higher proportion of plant fragments created and then redistributed throughout the lake. For these lakes, boating activity combined with available littoral habitat may be largely responsible for the high level of infestation observed in the survey. In lakes where *M. Spicatum* was found in low levels, natural water color (e.g., Lake Desire), past herbicide use, or other ongoing aquatic plant management activities may have resulted in the reduced levels of *M. Spicatum* infestation which were observed. For other lakes, the infestation may be just beginning and will continue to worsen over time, eventually becoming problematic for lake users.

Lythrum salicaria (Purple Loosestrife)

Lythrum salicaria is a tall perennial herb with multiple stems which originate from a woody root system. The stems are characteristically square in cross section. The lance shape leaves are typically opposite but occasionally can be found in whorls of three or alternately along the plant stem. The bright magenta flowers on a terminal spike are one of the most distinguishing features of this herb.

The plant is very invasive and can take over a shoreline or wetland area in just a few years since mature plants generally produce a million or more viable seeds each year. The plant also reproduces vegetatively from the root stock and from stem fragments, which further hinders successful removal. The tiny seeds have little food value and the thick plant stands deter wildlife use for nesting or cover.

L. salicaria was first introduced into North America during the 1800s. The plant quickly spread throughout the east and Great Lakes states after its introduction and eventually found its way west. The plant was first documented in Washington during the 1920s. Limited historical information on *L. salicaria* presence is available in the King County wetlands inventory.

L. salicaria was found in 12 of the 36 lakes surveyed. The level of infestation varied from lake to lake ranging from just a few plants (Pine Lake) to extensive shoreline coverage (Lake Desire). For many of the lakes with small plant populations, hand-pulling methods combined with ongoing surveying could be used to eradicate *L. salicaria* from the shoreline.

Hydrilla verticillata (Hydrilla)

Hydrilla verticillata closely resembles both *Egeria densa* and *Elodea candensis* which are found in Washington. *H. verticillata* is readily distinguished by the presence of small, peanut-sized tubers found at the end of underground rhizomes. The leaves can be found along the plant stem in whorls of three-eight and can be distinguished by their serrated edges.

H. verticillata had not been identified in Washington until its discovery in lakes Lucerne and Pipe during the SWM Division surveys. Since the discovery of *H. verticillata* in these King County lakes, the SWM Division, with the assistance of the Washington Department of Ecology (and an Aquatic Weed Management Fund grant), has completed the second year of management efforts to eradicate the plant from the lakes.

No other SWM-surveyed lakes were found to contain *H. verticillata.* In addition to the comprehensive diver survey of lakes Lucerne and Pipe performed by Thurston County divers, nearby lakes Meridian, Sawyer, and Wilderness were also diver surveyed during 1995. *H. verticillata* was not found in any of these diver surveyed lakes.

Phalaris arundinacea (reed canary grass)

This perennial grass grows between three and five feet tall from spreading underground rhizomes. The plant was originally introduced as forage for cattle and is commonly found invading wet open areas which have been disturbed. The grass is ideally suited to highly fluctuating water tables which are common to lake shorelines. The plant provides little habitat for waterfowl and wildlife because of its dense growth. Few species, other than cattle, enjoy it as a food source. Lakes Beaver and Twelve were the only shorelines where this species was observed.

Iris pseudacorus (yellow iris)

This non-native emergent plant grows from underground rhizomes to a height of three feet. The showy yellow flowers make the plant rather attractive. However, like most noxious species, the non-native iris replace more beneficial species including cattails, sedges, rushes, and other native shoreline vegetation. The yellow iris was found on 32 of the 36 surveyed lakes. This species was frequently observed along residential portions of the shoreline which had been altered or disturbed in some fashion. In many of the surveyed lakes, the plant was well established and was continuing to spread to other disturbed sites.

Nymphaea odorata (white/pink waterlily)

The white or pink fragrant waterlilies are probably the most easily recognized aquatic plant species. The large floating leaves are nearly round and are generally between six and 12 inches in diameter. The flowers are white or pink with many petals. This plant was introduced to many King County lakes as a horticultural specimen by lakeside residents and was found on 27 of the 36 surveyed lakes. The plant can become a problem in shallow embayments, restricting access to open water areas of a lake. Although residents were well intentioned with this plant introduction, this species is now the target of most aquatic plant management complaints. The plant is difficult to remove because of its large underground tuber which continues to send up new shoots throughout the growing season.

PROBLEMS ENCOUNTERED DURING THE PROJECT

Lake Size Determination

Discrepancies between aerial mapping results and historical delineations in the literature (USGS, 1976) of lake size were observed during data reduction for this project. In some instances, these differences were small (less than 5 percent) while in other instances, the differences were much larger (65 percent). Table 6 summarizes the number of affected lakes in four categories of relative difference. Most lakes were very close to their original size estimates (Table 7).

The accuracy of size determination of a lake is largely dependent upon the method used. Many early determinations of lake size where made from aerial photographs and/or topographic map delineations. Depending upon the scale of the base map and the accuracy of the instrument used in determining the delineation, lake area determinations could vary significantly from one method to another.

For lakes where the relative difference was greater than 15 percent, additional Global Positioning System (GPS) points were obtained to assist in the determination of the

Table 7: Percent Areal Change Between Historical and 1995 Aerial Delineation

Relative Difference	Number of Affected Lakes
Less than 5 percent	17
Between 5 and 10 percent	7
Between 10 and 15 percent	6
Greater than 15 percent	6

true lake size. The affected lakes included Desire, Dolloff, Francis, Killarney, McDonald, and Panther. For all other lakes, lake size and percent coverage are reported based on data collected from the 1995 aerial mapping survey only.

Plant Identification

For this project, mapping activities were targeted from mid-July through August to maximize the survey team's ability to collect mature plant specimens and facilitate accurate plant identification. Plant collection occurred during the scheduled survey day(s) on an individual lake. Plant material was collected for each lake. For some specimens, floral parts or mature plant specimens where not available at the time of collection and sometimes limited plant identification to the genus level. Additionally, without mature specimens many of the grasses, sedges, or rushes could not be identified beyond genus.

Herbaria

Aquatic plant specimens were collected for all lakes surveyed. These specimens were used to verify field identification and for the development of lake herbaria. For many lakes, a complete herbarium was developed. For several lakes, however, plant material quality was inadequate for preservation and plant decay occurred before the specimens could be completely dried. Ongoing collection will be used to support completion of individual lake herbaria. During 1996, additional specimens were collected by SWM staff from lakes Dolloff, Fivemile, Geneva, Shadow, Spring, Star, and Trout to complete herbaria for these lakes.

GPS Points

The collection of Global Positioning System (GPS) location information (points) is dependent upon reception of satellite signals. In some instances, location could not be obtained because of poor signal reception which was constrained by boat location on the lake. Large objects including trees and homes, and surrounding topography at times interfered with the survey team's ability to pick up the satellite signals. Since collection of GPS information was a secondary goal for the project, time often dictated how long the team could afford to try and improve position on the lake to pick up a good signal. Difficulty in a signal reception was also compounded by the confines of the boat and the limited ability to raise the signal receiving equipment to a greater height as is frequently done in land-based GPS mapping. In cases where signals could not be picked up at all, the location on the lake was adequately referenced on the field map using sightings to fixed landmarks.

RECOMMENDATIONS

The permitting framework for aquatic plant management should be evaluated for possible revisions or additions which would more directly address public and community needs for management of aquatic plants in freshwater lakes in King County. Potential changes include the addition of a lakes definition, development standards, permitted management activities, mitigation requirements, and other appropriate development or land management requirements for lakes and their shorelines in the King County Code.

Second, noxious aquatic plants should be targeted for eradication in King County lakes where feasible. Currently, lakes Killarney, Wilderness, and Twelve have completed or are in the process of completing integrated aquatic plant management plans (IAPMP). These three plans address noxious weed removal and control, as well as long-term aquatic plant management recommendations. For those remaining lakes which have *M. spicatum,* King County should prioritize IAPMP grant assistance to these lakes based on public access, community support, long-term management goals, likelihood for eradication, and severity of the problem. Additionally, any pending jurisdictional changes should be considered in the IAPMP prioritization process (i.e., Lake Meridian is now within the city of Kent).

For *L. salicaria,* King County should pursue eradication through volunteer events supported through a WSDOE Aquatic Weed Management Fund grant and ongoing SWM Division events. A pilot program targeting *L. salicaria* eradication at several lakes should be pursued as a grant project to develop a sustaining volunteer removal plan for use at all affected King County lakes.

A second grant should be sought to support a pilot program to train volunteers in the identification and monitoring of noxious aquatic weeds. As part of the pilot program, noxious weed identification materials would be developed for eight of the most likely invasive aquatic species including *L. salicaria* and *M. spicatum.* Training would target all interested lakes as well as focus on early-detection monitoring for lakes currently not impacted by noxious weeds. Volunteer monitors would be trained in plant survey techniques and provide ongoing noxious weed assessment and removal.

For other lakes where noxious weeds are not the primary aquatic plant problem, IAPMP grant assistance should be prioritized based on floating and submergent plant coverage in proportion to total lake size, documentation of beneficial use degradation, and community support. Additionally, public access, long-term management goals, likelihood for successful control, severity of the problem, and any pending jurisdictional changes should be considered in the prioritization process.

Floating and submergent aquatic macrophytes still commonly present a lake use problem for many lake residents. However, the problem may not be severe or complex enough to recommend an IAPMP. Moreover, citizen requests for aquatic plant management information to the SWM Division's Lake Stewardship Program is typically related to available methods for the removal of *Nymphaea odorata*. This public request is not unusual given that 27 of the 36 lakes surveyed have this plant (with average floating plant coverage of 4.2 acres) along their shorelines.

To address this localized aquatic plant management need, the development of permissible aquatic plant management actions which an individual homeowner can use should be pursued by King County. Current shoreline and sensitive area regulations present several obstacles for legal removal of any problematic plants. Additionally, lack of citizen knowledge regarding aquatic plant management regulations or, in some cases disregard of the regulations altogether, results in the illegal application of herbicides to the problematic plants, removal of the plants by hand, illegal placement of bottom barriers, or other more radical methods to reduce or control plant growth. Without reasonable alternatives for lake residents to use, illegal methods will continue to be used and, the balance needed between human shoreline uses and aquatic plant benefits may never be reached.

A variety of hand operated cutting tools are available for controlling aquatic plants. King County should develop guidelines for their use as an alternative to address individual aquatic plant control needs as well as explore other similar techniques or tools suitable for individual aquatic plant control. A new brochure could be developed that targets aquatic plant control options for individual lakeside residents where IAPMP would not be appropriate and localized control is the primary objective.

Finally, the SWM Division, through its Lake Stewardship Program, should continue to perform public education and involvement regarding the importance and benefits of native aquatic plants in a healthy lake system. Training volunteers in the identification of noxious aquatic weeds and encouraging their involvement in identifying new infestations should also remain an important component of the Stewardship Program to protect King County lake resources.

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