

Lake Ki

Lake Ki appears to be in healthy condition, with high water clarity, low phosphorus, and low levels of algae and aquatic plants. Control of runoff and nutrients from homes around the lake and in the watershed is key to maintaining the health of this naturally clear lake.

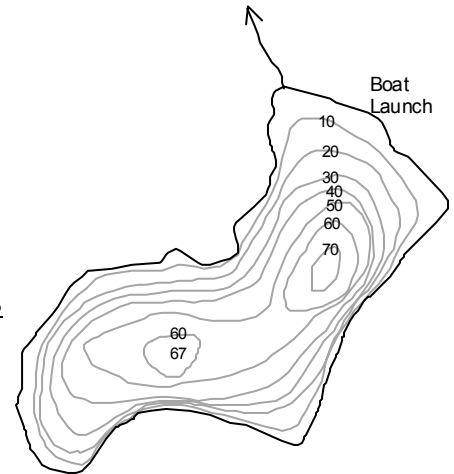


State of the Lakes Report
March 2003

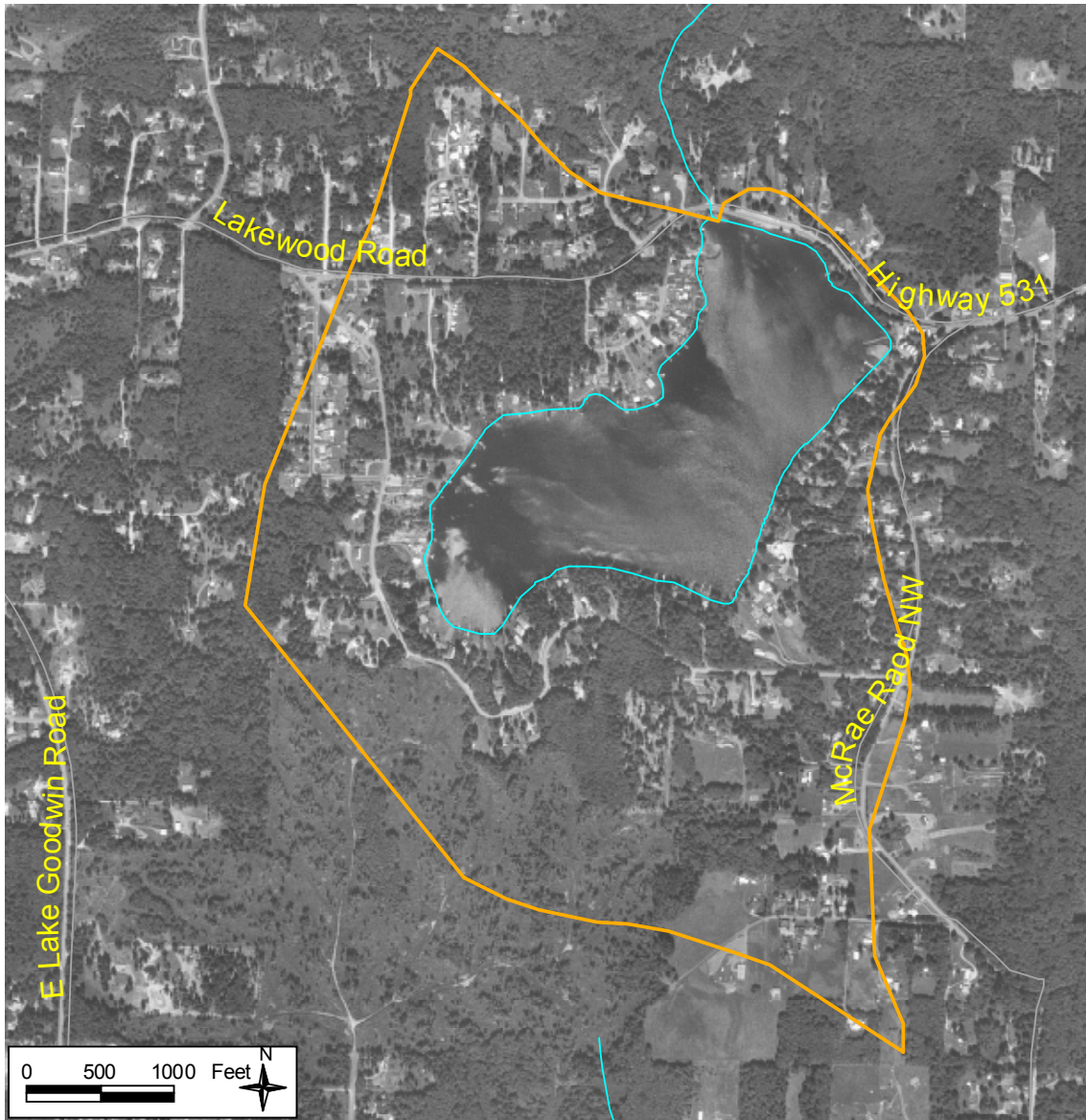
Snohomish County Public Works
Surface Water Management

LAKE AND WATERSHED DATA

Lake Area: 96 acres
 Watershed Area: 452 acres
 Watershed to Lake Area Ratio: 4.7
 Maximum Depth: 70 feet (21.3 meters)
 Average Depth: 33 feet (10.1 meters)
 Lake Volume: 3300 acre-feet
 Length of Shore: 1.9 miles



	<u>1974</u>	<u>MID-90'S</u>
# of nearshore homes	82	90
# of homes/1000' of shoreline	8.2	9.0
% of homes with bulkhead or fill		71%
% of homes with some native vegetation near shore		29%
% of watershed developed (residential or commercial)	11%	40% (est.)



LAKE ASSESSMENT

DESCRIPTION

■ ***Location/Access***– Lake Ki is located in the Seven Lakes area north of the Tulalip Reservation. The lake is fed by ground water and precipitation. The outlet stream flows north into Fish Creek and ultimately to the Stillaguamish River. There is public access along the shoulder of State Highway 531 (Lakewood Road), which runs on the north side of the lake. Power boats are permitted, but restricted to 10 hp and a maximum speed of 8 mph.

■ ***Size/Shape***– The lake is 96 acres in size and one of the deepest lakes in the county, with a maximum depth of 21.3 meters and an average depth of 10.1 meters. The lake volume contains 3300 acre-feet of water.

■ ***Watershed***– The Lake Ki watershed, including the lake, covers 452 acres. The watershed is small, only 4.7 times the size of the lake. A small watershed means that there should be less potential for impacts from pollution coming from the surrounding lands than at a lake with a large watershed. In 1973, 11% of the watershed was developed with residential uses. By the mid-1990s, residential development had increased to approximately 40% of the watershed, and growth is continuing.

■ ***Shoreline***– The shoreline of Lake Ki is 1.9 miles in length. Along the shoreline, there were 82 homes or cabins in 1973. This number had increased to 90 by the mid-90s, which is above average density for lakes in the county. The shoreline is also one of the most modified in the county—about 71% of the nearshore homes have added bulkheads or fill. Only 29% of the homes have retained some native vegetation along the shore. A zone of vegetation is important for filtering pollution.

LAKE CONDITIONS

■ ***Water Clarity***– Summer water clarity in Lake Ki is the highest of any lake in Snohomish County. From 1992 through 2002, summer water clarity



averaged between 7.1 and 8.7 meters. Water clarity was less during the 1983 Entranco study, averaging 5.8 meters. Single measurements in 1974 and 1981 were even lower. The reasons for higher water clarity since 1992 are unknown, but it is likely that high water clarity is the natural condition for such a deep lake surrounded by a small watershed.

■ ***Color***– The lake water is nearly colorless according to laboratory measurements. Field observations usually characterize the water as light green.

■ ***Nutrients***– Summer average total phosphorus concentrations in the epilimnion ranged from 2 to 12 $\mu\text{g/l}$ between 1996 and 2002, which is low for Snohomish County lakes. Samples from 1974, 1981, and the 1983 study showed similar values. Total phosphorus averages in the hypolimnion were slightly higher, ranging from 8 to 21 $\mu\text{g/l}$ from 1996 to 2002. Historic values were similar, but one measurement in 1981 showed a hypolimnion concentration of 90 $\mu\text{g/l}$. These data suggest that there is a limited release of phosphorus from the bottom sediments during times of oxygen depletion. Composite total phosphorus samples taken by the Department of Ecology from 1993 to 1997 are not directly comparable to the discrete samples discussed above, but confirm that Lake Ki has low phosphorus levels. Total nitrogen concentrations measured in 1974, 1981, and 1993-1996, and nitrate and ammonia measured in 1983-1984, were generally low. However, nitrogen

availability probably does not limit algal growth because phosphorus concentrations are much lower.

- ***Alkalinity***– Data from 1986 and the mid-90s indicate that Lake Ki has a very low buffering capacity and is sensitive to nutrient pollution.

- ***Oxygen/Temperature***– Vertical profiles of dissolved oxygen and temperature for the summers of 1995 to 2002 show strong stratification between warm, oxygenated upper waters and cool, oxygen-depleted bottom waters. The graphs indicate adequate dissolved oxygen levels down to about 12 meters, but the oxygen is depleted below that depth by late summer. This indicates the presence of decomposing organic matter in the lake bottom which consumes the oxygen. The graphs also show frequent spikes of higher dissolved oxygen at 6 to 9 meters depth, suggesting vigorous algal growth at this level. The high levels of clarity in Lake Ki mean that sunlight can penetrate to a greater depth than in other lakes. This helps create a larger zone of warm water and provides the heat and light needed for photosynthesis by algae in both the epilimnion and metalimnion.

- ***Algae***– Chlorophyll *a* data from the summers of 1981, 1983, and 1993-1996 produced values ranging from 0.4 to 3.0 µg/l, with one high value of 10.1 µg/l in 1994. Four samples from 2002 averaged 0.6 µg/l. These data indicate low amounts of algae in the lake, except for the one high value which likely corresponds with an algal bloom. Analysis of three samples in 1994 and 1995 revealed a diverse algal community dominated by greens, gold-browns, and dinoflagellates, with only small amounts of blue-green algae.

- ***Aquatic Plants***– Because of fairly steep slopes, limited shallow areas, and low organic sediments, Lake Ki supports a sparse to moderate concentration of aquatic plants. The main plants are natives—yellow water-lily, elodea, tapegrass, muskgrass, spikerush, and pondweed. There are also dense patches of non-native fragrant water-lily at the north and northeast corners of the lake.

- ***Water Levels***– There were concerns about high water levels in Lake Ki in the mid-90s. After a few properties were flooded during periods of heavy rain, there were discussions about lowering the fixed weir box that controls the outflow under Highway 531. However, the community consensus was to keep the weir at the existing level because that provided the best compromise between winter and summer water levels.

SUMMARY

- ***Trophic State***– Based on high water clarity, low phosphorus concentrations, and low amounts of algae and aquatic plants, Lake Ki may be classified as oligotrophic.

- ***Current Conditions/Trends***– Lake Ki appears to be in healthy condition. Monitoring data do not show any statistically significant trends in water quality. However, water clarity has been higher during the 1990s and 2000s than in prior decades.

- ***Future Concerns/Targets***– The main concern for Lake Ki is to maintain good water quality in the face of potential future development in the watershed. Lake Ki is a valuable lake that should not risk degradation. The one high hypolimnion phosphorus measurement and the one high chlorophyll *a* measurement may be signs of potential future eutrophication. Maintaining current water clarity and phosphorus levels is the target for the lake.

- ***Recommendations***– Monitoring should focus on identifying any changes to water clarity, nutrients, or algal production. New development in the watershed should take precautions to control runoff and reduce nutrient pollution. Existing homes on the lake shore should be encouraged to re-create buffers of native vegetation to filter out pollution before it reaches the lake.

CITIZEN VOLUNTEERS

Thanks to Pam and Scott Seiber, Idell Nieforth, and Kathy Nairn for volunteer monitoring at Lake Ki. Thanks also to the Department of Ecology and other citizen volunteers for past lake monitoring.

DATA SUMMARY TABLE

Source	Date	Secchi Depth (meters)	Total Phosphorus (ug/l)		Color (Pt-Co scale)	Chlorophyll a (ug/l)
			Surface	Bottom	Epilimnion	Epilimnion
Bortleson, et al, 1976	6/20/74	3.7	7	19	10	-
Sumioka and Dion, 1985	7/6/81	4.3	10	90	-	2.2 -
Entranco, 1986	Summer 1983	4.8 - 6.5 (5.8) <i>n</i> = 5	<5 (<5) <i>n</i> = 5	7 - 14 (10) <i>n</i> = 5	-	0.4 - 2.9 (1.8) <i>n</i> = 5
Volunteer	Summer 1992	7.4 - 9.8 (8.4) <i>n</i> = 5	-	-	-	-
Volunteer or DOE	Summer 1993	6.1 - 9.3 (7.1) <i>n</i> = 12	-	-	-	1.7 - 3.0 (2.4) <i>n</i> = 2
SWM Staff or DOE	Summer 1994	7.0 - 8.9 (7.6) <i>n</i> = 13	-	-	<5 (<5) <i>n</i> = 2	1.9 - 10.1 (4.9) <i>n</i> = 3
SWM Staff or DOE	Summer 1995	7.0 - 9.4 (8.0) <i>n</i> = 12	-	-	<5	1.3 - 1.9 (1.6) <i>n</i> = 3
SWM Staff or DOE	Summer 1996	6.7 - 8.1 (7.3) <i>n</i> = 10	<2 - 3 (2) <i>n</i> = 2	7 - 8 (8) <i>n</i> = 2	-	1.8 - 2.1 (2.0) <i>n</i> = 2
SWM Staff or DOE	Summer 1997	4.2 - 8.8 (7.4) <i>n</i> = 8	4 - 11 (8) <i>n</i> = 2	16 - 17 (17) <i>n</i> = 2	-	-
SWM Staff	Summer 1998	6.8 - 8.2 (7.5) <i>n</i> = 4	3 - 10 (5) <i>n</i> = 4	15 - 26 (20) <i>n</i> = 4	-	-
SWM Staff	Summer 1999	6.0 - 8.6 (7.5) <i>n</i> = 4	4 - 6 (5) <i>n</i> = 4	15 - 30 (21) <i>n</i> = 4	-	-
SWM Staff	Summer 2000	7.1 - 7.9 (7.6) <i>n</i> = 4	4 - 10 (6) <i>n</i> = 4	15 - 21 (18) <i>n</i> = 4	-	-
Volunteer	Summer 2001	8.0 - 9.5 (8.7) <i>n</i> = 7	8 - 18 (12) <i>n</i> = 4	6 - 26 (13) <i>n</i> = 4	-	-
SWM Staff or Volunteer	Summer 2002	6.3 - 9.2 (7.6) <i>n</i> = 5	5 - 10 (9) <i>n</i> = 4	8 - 27 (17) <i>n</i> = 4	-	0.1 - 1.6 (0.6) <i>n</i> = 4

NOTES

- Table includes summer (May-Oct) data only.
- Each box shows the range on top, followed by summer average in () and number of samples (n).
- Total phosphorus data are from samples taken at discrete depths only.
- DOE = Washington Department of Ecology

SUMMARY OF OTHER DATA

■ **Total Phosphorus** – composite samples taken by the Department of Ecology from 1993-1997 ranged from 5 -- 14 µg/l in the epilimnion and 10 - 28 µg/l in the hypolimnion. These are not directly comparable to the discrete samples shown above, but confirm that Ki has low phosphorus levels.

■ **Nitrogen** – values from a 1974 total nitrogen sample were 0.46 mg/l in the epilimnion and 0.44 mg/l in the hypolimnion; a 1981 sample was 0.55 mg/l in the epilimnion and 2.00 mg/l in the hypolimnion; 1983-1984 samples by Entranco showed low nitrate levels (averages of 0.057 mg/l in the epilimnion and 0.075 mg/l in the hypolimnion, with values up to 0.201 in the epilimnion) and low to moderate ammonia concentrations (averages of 0.018 mg/l in the epilimnion and 0.117 mg/l in the hypolimnion, with values up to 0.273); total nitrogen data from 1993-1996 Ecology samples averaged 0.26 mg/l in the epilimnion and 0.30 mg/l in the hypolimnion; these data suggest nitrogen availability is low but not low enough to limit algal growth.

■ **Alkalinity** – data from 1983 ranged from 5 – 15 mg/l CaCO₃ while 1994 and 1995 data ranged from 5 – 9.5 mg/l CaCO₃, which suggests that Ki has a very low buffering capacity and is sensitive to nutrient pollution.

■ **pH** – 1994-2000 data averaged 7.1 near the surface and 6.1 near the bottom, which is close to neutral.

■ **Conductivity** – data from 1983 ranged from 38 – 58 µmhos; 1994-2000 data averaged 40 µmhos in the epilimnion and 45 µmhos near the lake bottom, indicating low levels of dissolved materials in the water.

■ **Iron** – limited 1994-95 data showed low levels in the epilimnion (avg. 17 µg/l) and slightly higher levels in the hypolimnion (avg. 224 µg/l, high of 360 µg/l), which indicates minor release of iron

and phosphorus from the bottom sediments under low oxygen conditions.

■ **Algae** – the following table shows the total biovolume and percent biovolume of the main types of algae from three samples collected in 1994-95. The data show that the total algal volumes were low in two samples and that greens, gold-browns, and dinoflagellates were each most prevalent at times. Cell counts of the same samples revealed that green algae were most abundant, ranging from 33% to 73%.

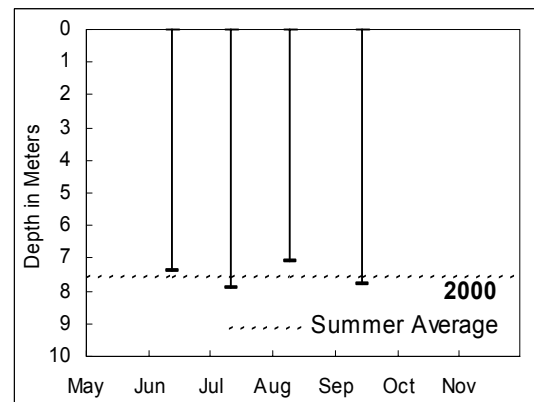
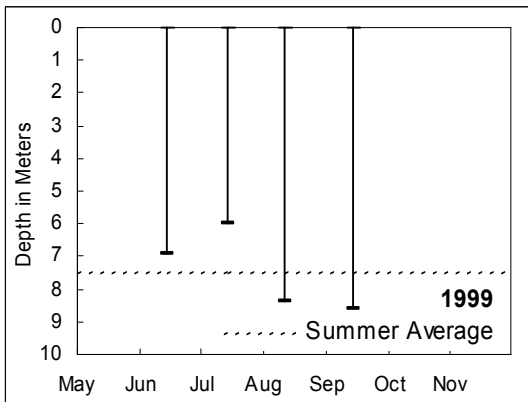
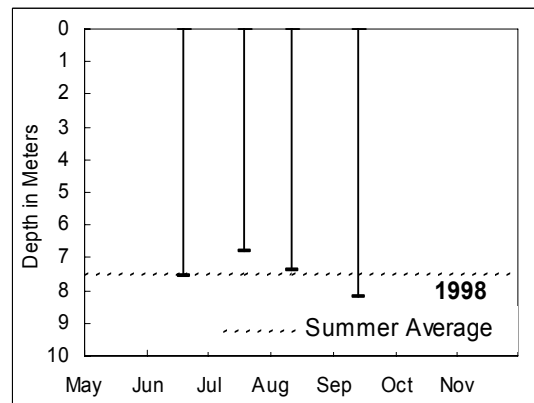
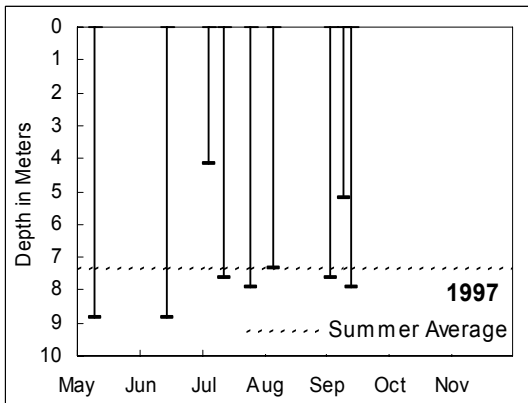
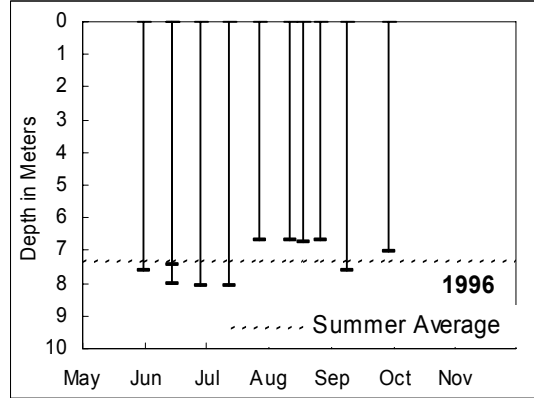
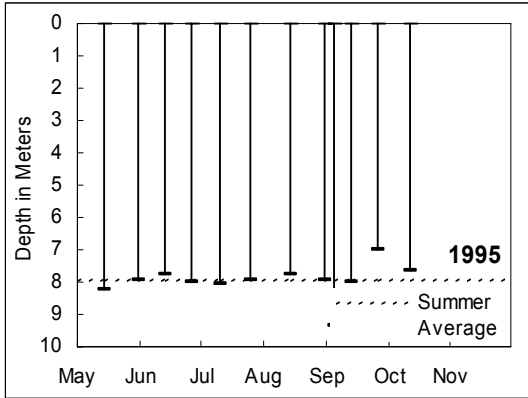
ALGAE TYPES	7/6/94	9/2/94	9/6/95
Cyanophyta (Blue-greens)	1%	0%	0%
Chlorophyta (Greens)	23%	62%	20%
Chrysophyta (Golden/diatoms)	75%	21%	25%
Cryptophyta (Cryptomonads)	1%	1%	10%
Euglenophyta (Euglenoids)	0%	0%	0%
Pyrrhophyta (Dinoflagellates)	0%	16%	45%
TOTAL BIOVOLUME (mm ³ /l)	1.153	0.126	0.319

■ **Fish** – according to the Washington State Department of Fish and Wildlife (WDFW), fish species found in Lake Ki include rainbow trout, largemouth bass, and yellow perch. WDFW usually stocks the lake each year with rainbow trout.

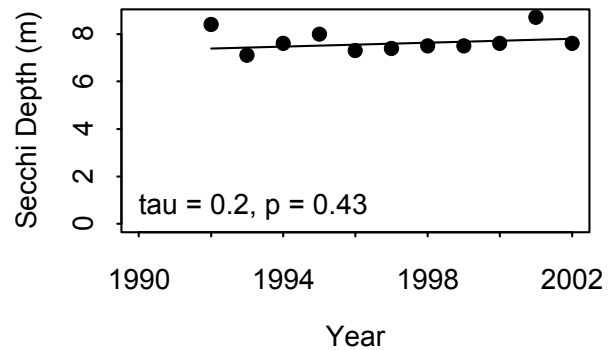
DATA SOURCES

In addition to data from Snohomish County SWM staff and citizen volunteers, data for Lake Ki are also available from: Bortleson, et. al., 1976; Entranco Engineers, 1986; Rector, 1996; Smith and Rector, 1997; Smith, et. al., 2000; and Sumioka and Dion, 1985. Please refer to the full list of references in the County-Wide Summary.

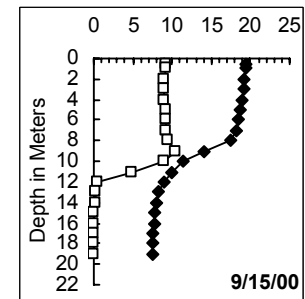
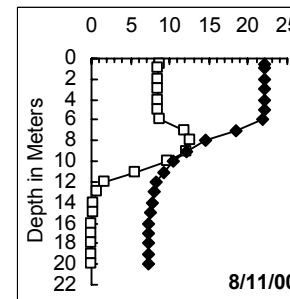
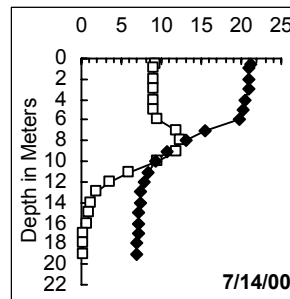
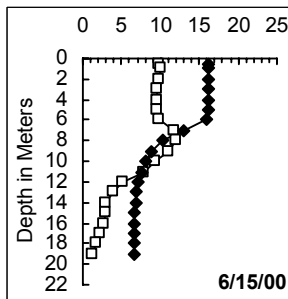
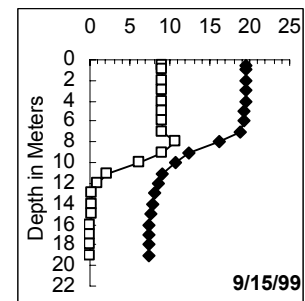
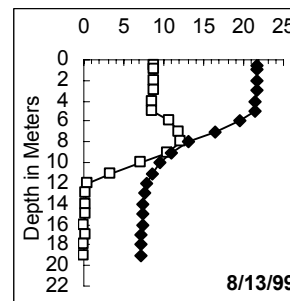
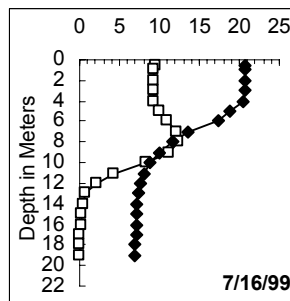
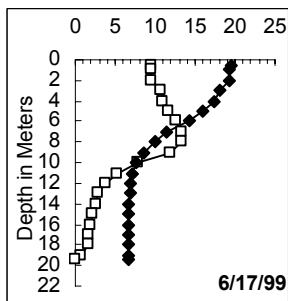
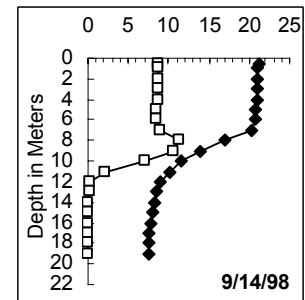
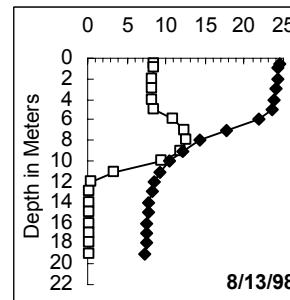
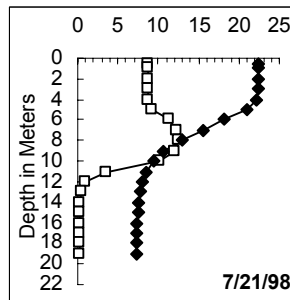
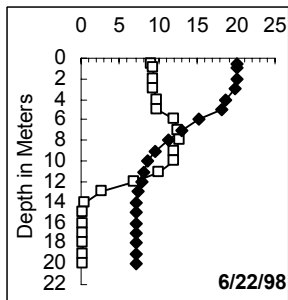
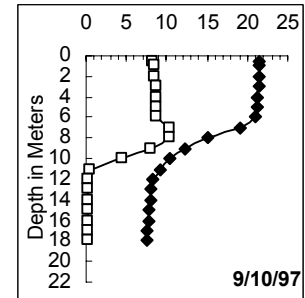
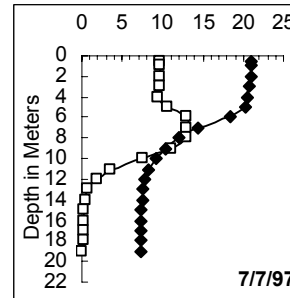
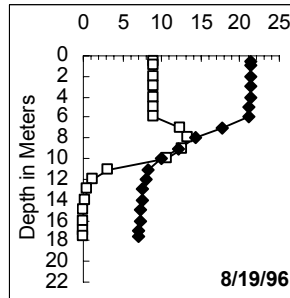
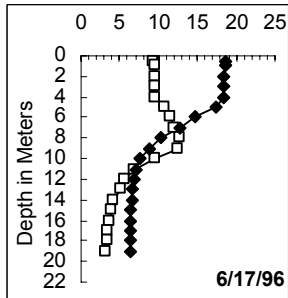
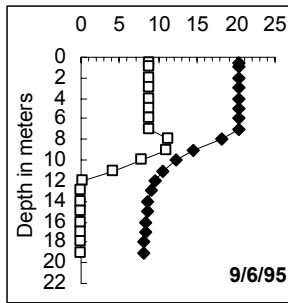
WATER CLARITY



TREND ANALYSIS

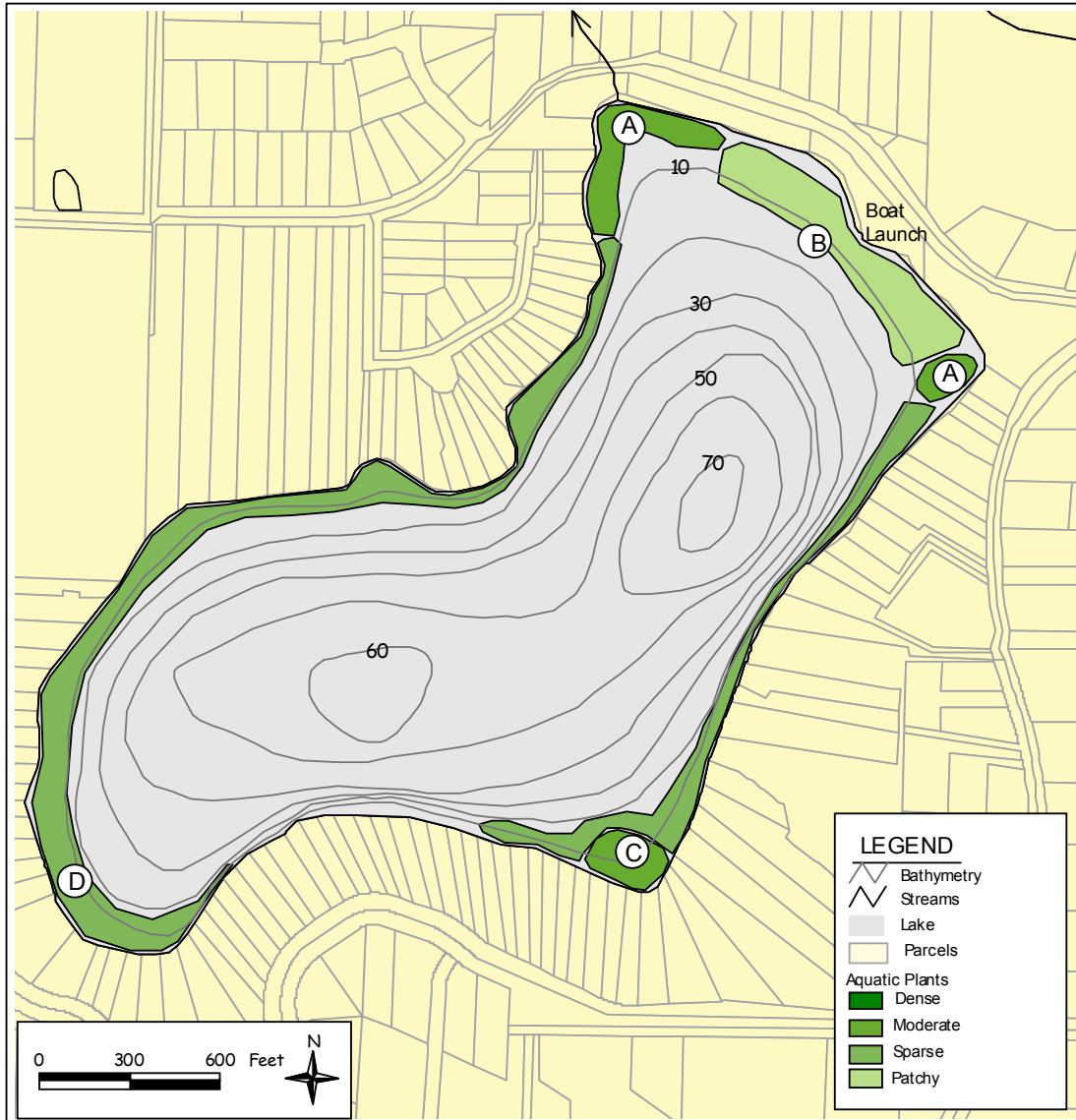


DISSOLVED OXYGEN AND TEMPERATURE PROFILES (SELECTED YEARS)



□ DO (mg/l) ◆ Temp (°C)

AQUATIC PLANTS



Area	Density	Dominant Plants	Other Plants
A	Moderate	<i>Nymphaea odorata</i> (Fragrant water-lily)	<i>Chara sp.</i> (Stonewort, Muskgrass) <i>Eleocharis sp.</i> (Spikerush)
B	Sparse	<i>Eleocharis sp.</i> (Spikerush) <i>Chara sp.</i> (Stonewort, Muskgrass)	<i>Vallisneria americana</i> (Tapegrass) <i>Elodea canadensis</i> (Common elodea)
C	Moderate	<i>Vallisneria americana</i> (Tapegrass)	<i>Elodea canadensis</i> (Common elodea) <i>Potamogeton sp.</i> (Thin-leaf pondweed)
D	Patchy	<i>Nuphar polysepalum</i> (Yellow water-lily) <i>Elodea canadensis</i> (Common elodea) <i>Potamogeton sp.</i> (Thin-leaf pondweed)	

Note: *Iris pseudacorus* (Yellow Iris), a non-native, invasive plant, is scattered along the shore.

BASIC MONITORING DATA

1995									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
*9/6/95	9.35				50	none	breezy	clear	Very clear water. Some tiny algae observed at depth (7.5, 11m). Moderate sulfur smell below 14m.

1996									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
*6/17/96	8.0				50	heavy	breezy	lt green	Slight odor noted at bottom - but not H2S
*8/19/96	6.75				100	trace	light	medgreen	

1997									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
*7/7/97	4.2				10	trace	breezy	medgreen	Not as clear as past years. foam onshore - persistent.
*9/10/97	5.2				75	none	ltbreezy	lt green	

1998									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
*6/22/98	7.6				0	none	breezy	lt.green	
*7/21/98	6.8				0	none	light		Rotten egg odor
*8/13/98	7.4				0	none	light	lt green	Slight odor in bottom sample.
*9/14/98	8.2				10	none	calm	lt green	1 gull.

1999									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
*6/17/99	6.9	20	19.5		100	trace	light	lt green	No odor.
*7/16/99	6.0	19.4	20.7		75	moderate	calm	lt green	Slight odor from bottom sample.
*8/13/99	8.4	17	21.6		100	trace	light	lt green	Moderate odor from bottom sample.
*9/15/99	8.6	13	19.4		100	none	light	lt green	Foggy. Moderate odor from bottom sample.

*Indicates data collected by Snohomish County staff.

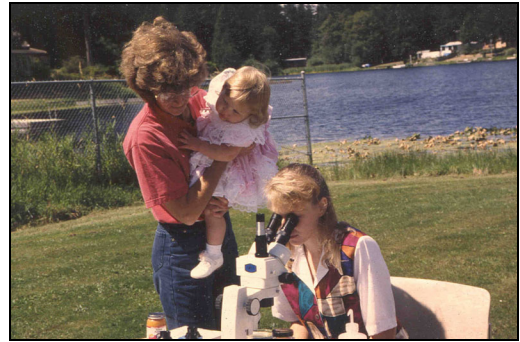
2000

DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
*06/15/00	7.4	14	16.26		75	moderate	breezy	lt green	No ducks, slight algae, and no algae scum or aquatic plants.
*07/14/00	7.9	22	21.09		10	none	strong	lt green	No ducks or algae scum, and slight algae and aquatic plants.
*08/11/00	7.1	19	22.18		90	none	light	lt green	2 ducks, slight algae and aquatic plants, and no algae scum.
*09/15/00	7.8	22	19.4		10	none	light	lt green	3 ducks, slight algae and aquatic plants, and no algae scum.

[Click here to view more recent data.](#)

HOW YOU CAN HELP LAKE KI

- Educate yourself about lake ecology and the lake's health.
- Use lawn and garden fertilizers sparingly; test your soil first; choose low or no phosphorus fertilizers.
- Retain or plant native vegetation adjacent to the water to protect the shoreline and filter pollution.
- Infiltrate or filter the runoff from rooftops, patios, and driveways rather than piping it to the lake.



- Cover or mulch bare soil areas.
- Use pesticides, herbicides, and household chemicals sparingly and never near the water.
- Maintain your septic system—have it inspected every two years and pumped when needed.
- Conserve water both inside and outside.
- Clean up pet wastes and keep livestock away from the lake shore.

- Learn to identify non-native invasive aquatic plants and animals; check your boat and trailer for invaders; never empty an aquarium into the lake.
- Do not feed geese or ducks.
- Join with neighbors or the local property owners' association to work together to protect the lake.



Contact Snohomish County Surface Water Management at 425-388-3464 for information about these topics or if you have questions about Lake Ki.

(TTY users call 425-388-3700)

