

# Lake Riley

Lake Riley appears to be in healthy condition, with moderate nutrient levels, moderate amounts of algae, and dense aquatic plants. Water clarity is low, mainly because the lake is a bog with darkly colored water. Maintaining the health of the lake depends on controlling nutrients from future development and from timber harvest in the surrounding watershed.



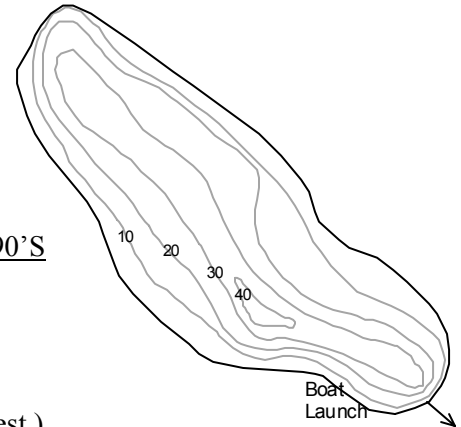
*State of the Lakes Report*  
*March 2003*

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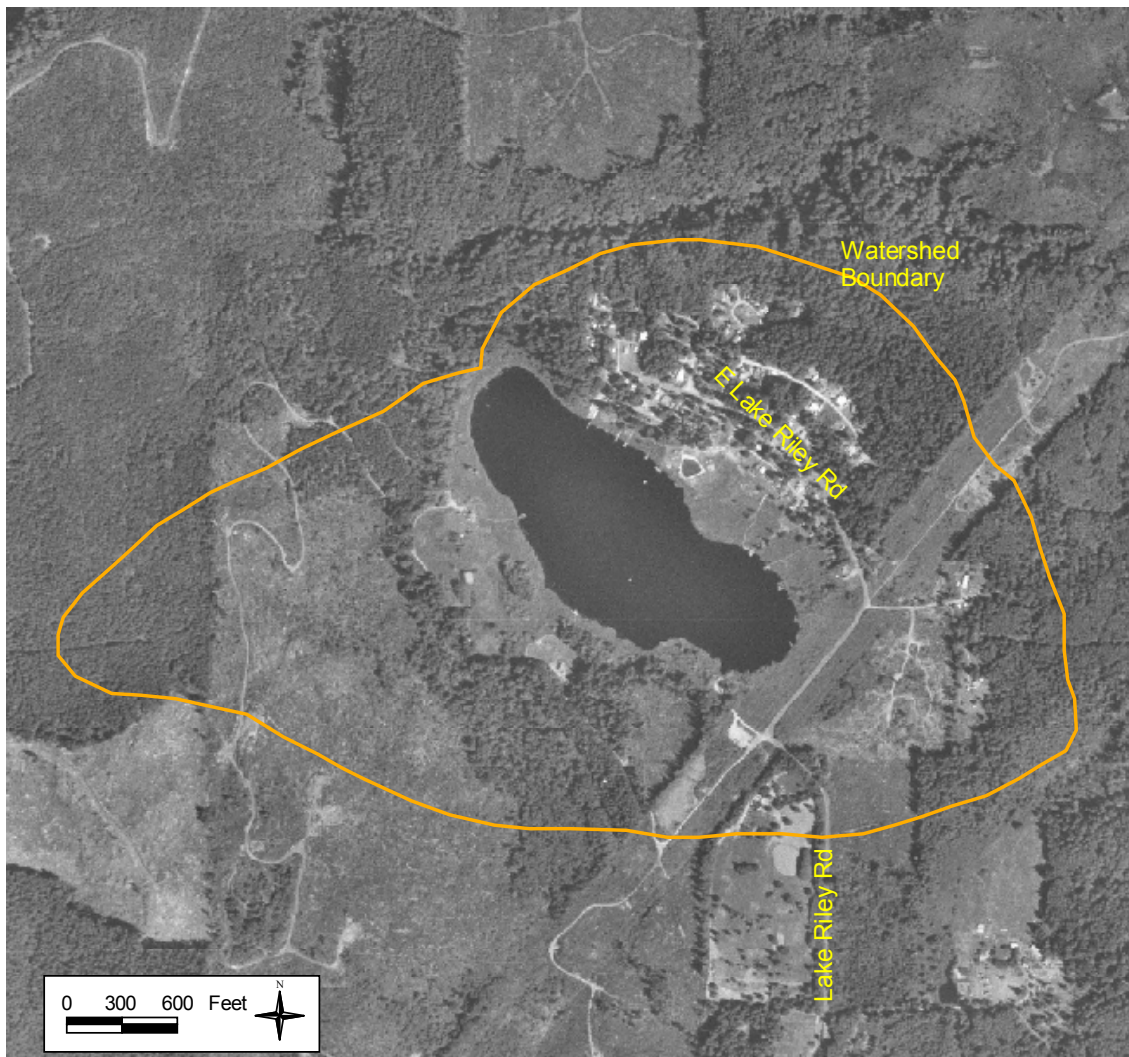
**Snohomish County Public Works**  
**Surface Water Management**

## LAKE AND WATERSHED DATA

Lake Area: 30 acres  
 Watershed Area: 273 acres  
 Watershed to Lake Area Ratio: 9.1  
 Maximum Depth: 45 feet (13.7 meters)  
 Average Depth: 22 feet (6.7 meters)  
 Lake Volume: 670 acre-feet  
 Length of Shore: 1.0 miles



	<u>1973</u>	<u>MID-90'S</u>
# of nearshore homes	14	18
# of homes/1000' of shoreline	2.8	3.6
% of homes with bulkhead or fill		0%
% of homes with some native vegetation near shore		100%
% of watershed developed (residential or commercial)	5%	10% (est.)



# LAKE ASSESSMENT

## DESCRIPTION

■ **Location/Access**– Lake Riley is a bog lake located in the Cascade Mountain foothills about 10 miles northeast of Arlington. There are no visible surface water inflows. The lake drains to Jim Creek and the south fork of the Stillaguamish River. There is a public boat launch near the south end of the lake. A private recreational development, Normanna Park, sits north of the lake and provides community access to the lake for members.

■ **Size/Shape**– The lake is 30 acres in size, with a maximum depth of 13.7 meters and an average depth of 6.7 meters. The lake volume contains 670 acre-feet of water.

■ **Watershed**– The Lake Riley watershed, including the lake, covers 273 acres. The watershed is about 9 times the size of the lake, which is a relatively small watershed. This means that there should be less potential for pollution impacts from the surrounding lands than at a lake with a large watershed. Most of the watershed was forested in 1973. The Normanna Park residential community covered only 5% of the watershed. By the mid-1990s, still only 10% of the watershed was developed. A major portion of the watershed west of the lake remains as commercial forest land.

■ **Shoreline**– The shoreline of Lake Riley is 1.0 miles in length. All of the homes along the shoreline are set far back because the lake is surrounded by dense wetlands. There were 14 homes near the lake shore in 1973 and 18 by the mid-90s—all but two situated in the Normanna Park community. The wetlands and immediate shoreline of the lake are undisturbed except for the private community beach, the public boat launch, and a few pathways and docks constructed for access to the water.

## LAKE CONDITIONS

■ **Water Clarity**– Water clarity in Lake Riley is consistently low compared to other lakes. From 1995 through 2002, summer water clarity averages



ranged from 1.7 to 2.5 meters. A single measurement in 1973 was comparable, but two readings in 1994 were higher—averaging 2.9 meters.

■ **Color**– The lake water is colored dark brown by dissolved organic (humic) materials from surrounding wetlands. This color does not affect water quality, but is a major reason for the low water clarity readings.

■ **Nutrients**– Summer average total phosphorus concentrations in the epilimnion ranged from 9 to 17  $\mu\text{g/l}$  from 1996 to 2002, which is low to moderate for Snohomish County lakes. Total phosphorus averages in the hypolimnion were higher, ranging from 19 to 27  $\mu\text{g/l}$  from 1996 to 2000, and averaging 70  $\mu\text{g/l}$  and 57  $\mu\text{g/l}$  in 2001 and 2002, respectively. This suggests low to moderate release of phosphorus from the bottom sediments during times of oxygen depletion. Single samples collected in 1973 showed somewhat lower levels of total phosphorus and moderate total nitrogen values. It appears that phosphorus was the nutrient limiting algal growth at that time.

■ **Alkalinity**– Data from 1994 and 1995 indicate that Lake Riley has a very low buffering capacity and is sensitive to nutrient pollution.

■ **pH**– Readings from 1994 through 2002 were near neutral (7.0) near the surface. Values near the lake bottom averaged 6.0 and were occasionally as low as 5.6. Based on these data, Riley is more

acidic than most Snohomish County lakes, which is consistent with being a bog lake.

- Oxygen/Temperature – Vertical profiles of dissolved oxygen and temperature for the summers of 1995 through 2002 show strong stratification between warm, oxygenated upper waters and cool, oxygen-depleted bottom waters. The graphs indicate that decaying organic matter in the lake bottom depletes the dissolved oxygen below about 3 or 4 meters depth by mid to late summer. On two occasions, the profiles show spikes in dissolved oxygen at 2 meters depth, suggesting vigorous algal growth at this level.

- Algae – Chlorophyll *a* data are available from three samples in the summers of 1994 and 1995 and four samples in 2002. The values ranged from 2.1 to 9.8 µg/l. These limited data suggest moderate levels of algal productivity in the lake. Analysis of three algae samples from 1994 and 1995 revealed moderate to high biovolumes, with green algae and gold-brown/diatoms most dominant. Levels of blue-green algae, which are responsible for most nuisance algal blooms, were moderate.

- Aquatic Plants – Because of the dark water color, there is only a narrow zone near the lake shore suitable for aquatic plants. In this zone, Lake Riley supports dense growths of aquatic plants. The dominant plants are watershield and thin-leaf pondweeds. Wetland plants are also abundant in shallow water and around the lake shore, including less common bog plants such as Labrador tea and sundew.

## SUMMARY

- Trophic State – Based on low water clarity (which is reduced by the dark color of the water), moderate phosphorus concentrations, moderate amounts of algae, dense aquatic plants, and severe oxygen depletion, Lake Riley may be classified as meso-eutrophic.

- Current Conditions/Trends – Lake Riley appears to be in healthy condition for a meso-eutrophic lake. Monitoring data have not revealed any statistically significant trends in water quality

since 1994. However, the higher total phosphorus concentrations in the hypolimnion in recent years may be a sign of changing conditions.

- Future Concerns/Targets – Potential threats to lake water quality are any significant new residential development or large scale timber harvest that could introduce more nutrients to the lake. Maintaining current water clarity and phosphorus levels is the target for the lake.

- Recommendations – The lake should be monitored to identify any changes in water clarity, nutrient levels, or algal blooms. The extensive wetlands surrounding the lake should be protected because they filter pollution and provide fish and wildlife habitat.

## CITIZEN VOLUNTEERS

Thanks to Weldon Sorgen, Sonya and Liv Engelson, Peggy Oard, and Jeff Aylor for volunteer monitoring at Lake Riley.

## **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	8/18/73	1.8	6	14	45	-
SWM Staff	Summer 1994	2.6 - 3.2 (2.9) n = 2	-	-	40 - 45 (43) n = 2	2.6 - 5.5 (4.1) n = 2
SWM Staff or Volunteer	Summer 1995	1.3 - 2.2 (1.7) n = 7	-	-	55	9.8
SWM Staff or Volunteer	Summer 1996	1.5 - 2.5 (1.8) n = 10	8 - 9 (9) n = 2	18 - 19 (19) n = 2	-	-
SWM Staff or Volunteer	Summer 1997	1.4 - 2.5 (1.8) n = 6	12 - 18 (15) n = 2	25 - 27 (26) n = 2	-	-
SWM Staff or Volunteer	Summer 1998	1.5 - 2.9 (1.9) n = 9	9 - 14 (12) n = 4	19 - 23 (22) n = 4	-	-
SWM Staff	Summer 1999	1.6 - 2.1 (1.9) n = 4	14 - 19 (17) n = 4	17 - 35 (27) n = 4	-	-
SWM Staff or Volunteer	Summer 2000	1.5 - 2.2 (1.9) n = 11	5 - 20 (16) n = 4	6 - 30 (21) n = 4	-	-
SWM Staff or Volunteer	Summer 2001	2.2 - 3.0 (2.5) n = 5	12 - 25 (17) n = 4	47 - 99 (70) n = 4	-	-
SWM Staff or Volunteer	Summer 2002	2.2 - 2.6 (2.4) n = 5	11 - 12 (11) n = 4	23 - 139 (57) n = 4	-	2.1 - 4.8 (3.1) n = 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.

## ***SUMMARY OF OTHER DATA***

■ ***Total Nitrogen*** – single samples in 1973 showed 0.41 mg/l in the epilimnion and 0.76 mg/l in the hypolimnion; which suggests that nitrogen was abundant and not limiting algal growth.

■ ***Alkalinity*** – data from 1994 and 1995 ranged from 7 – 9.7 mg/l CaCO<sub>3</sub>, which suggests that Riley has a very low buffering capacity and is sensitive to nutrient pollution.

■ ***pH*** – readings from 1994 through 2000 averaged 7.0 near the surface and 6.0 near the bottom, with occasional values as low as 5.6, which makes Riley more acidic than most Snohomish County lakes. Readings from 2002 were similar.

■ ***Conductivity*** – 1994-2000 data averaged 26 µmhos in the epilimnion and 36 µmhos near the lake bottom, indicating low levels of dissolved materials in the water. Readings from 2002 were similar.

■ ***Iron*** – limited 1994-95 data showed high levels in the epilimnion (avg. 133 µg/l) and the hypolimnion (avg. 1170 µg/l, high of 2200 µg/l), which indicates 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 relatively high and that greens and gold-browns/diatoms were most prevalent. Cell

counts of the same samples revealed that greens (72%), blue-greens (61%), and gold-browns/diatoms (38%) were each most abundant in one of the samples.

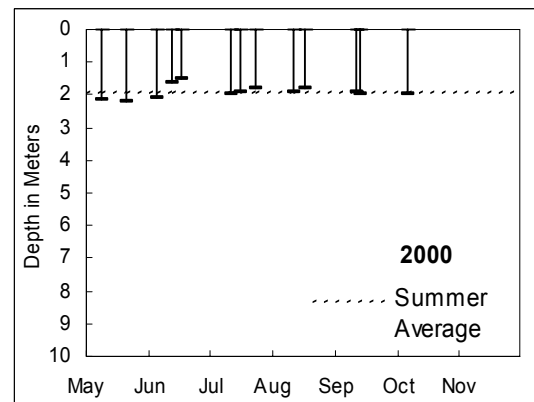
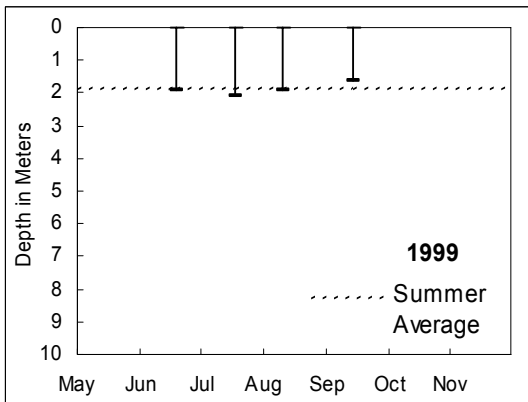
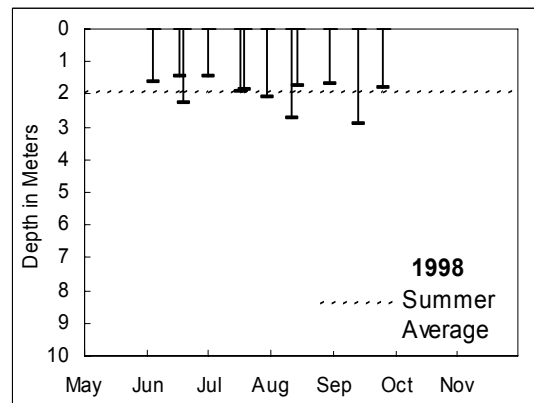
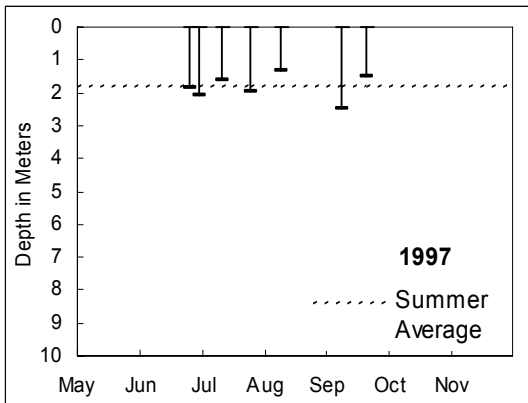
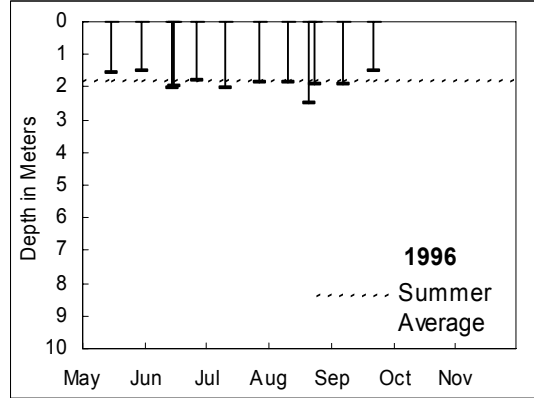
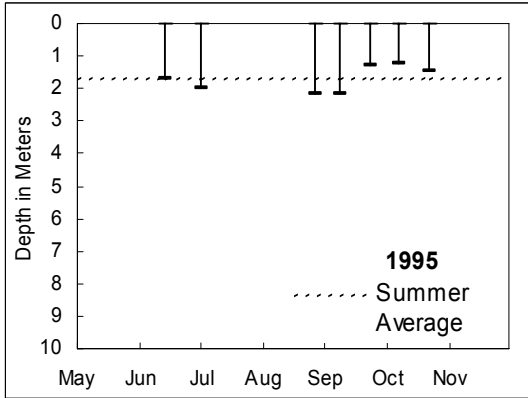
ALGAE TYPES	7/25/94	9/21/94	8/28/95
Cyanophyta (Blue-greens)	1%	24%	9%
Chlorophyta (Greens)	76%	39%	26%
Chrysophyta (Golden/diatoms)	18%	33%	42%
Cryptophyta (Cryptomonads)	1%	1%	9%
Euglenophyta (Euglenoids)	1%	1%	2%
Pyrrhophyta (Dinoflagellates)	3%	2%	13%
TOTAL BIOVOLUME (mm <sup>3</sup> /l)	0.756	1.426	2.569

■ ***Fish*** – according to the Washington State Department of Fish and Wildlife (WDFW), the main fish found in Lake Riley are rainbow trout, which are usually stocked each year by WDFW.

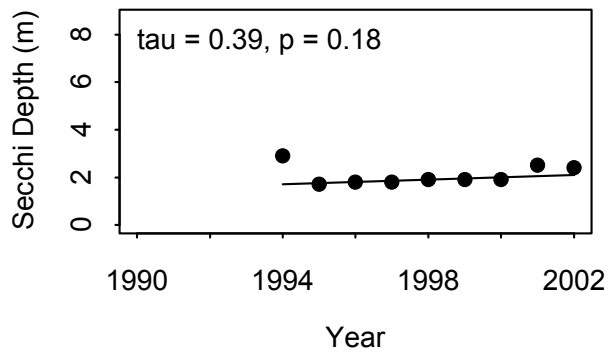
### **DATA SOURCES**

In addition to data from Snohomish County SWM staff and citizen volunteers, data for Lake Riley are also available from: Bortleson, et. al., 1976. Please refer to the full list of references in the County-Wide Summary.

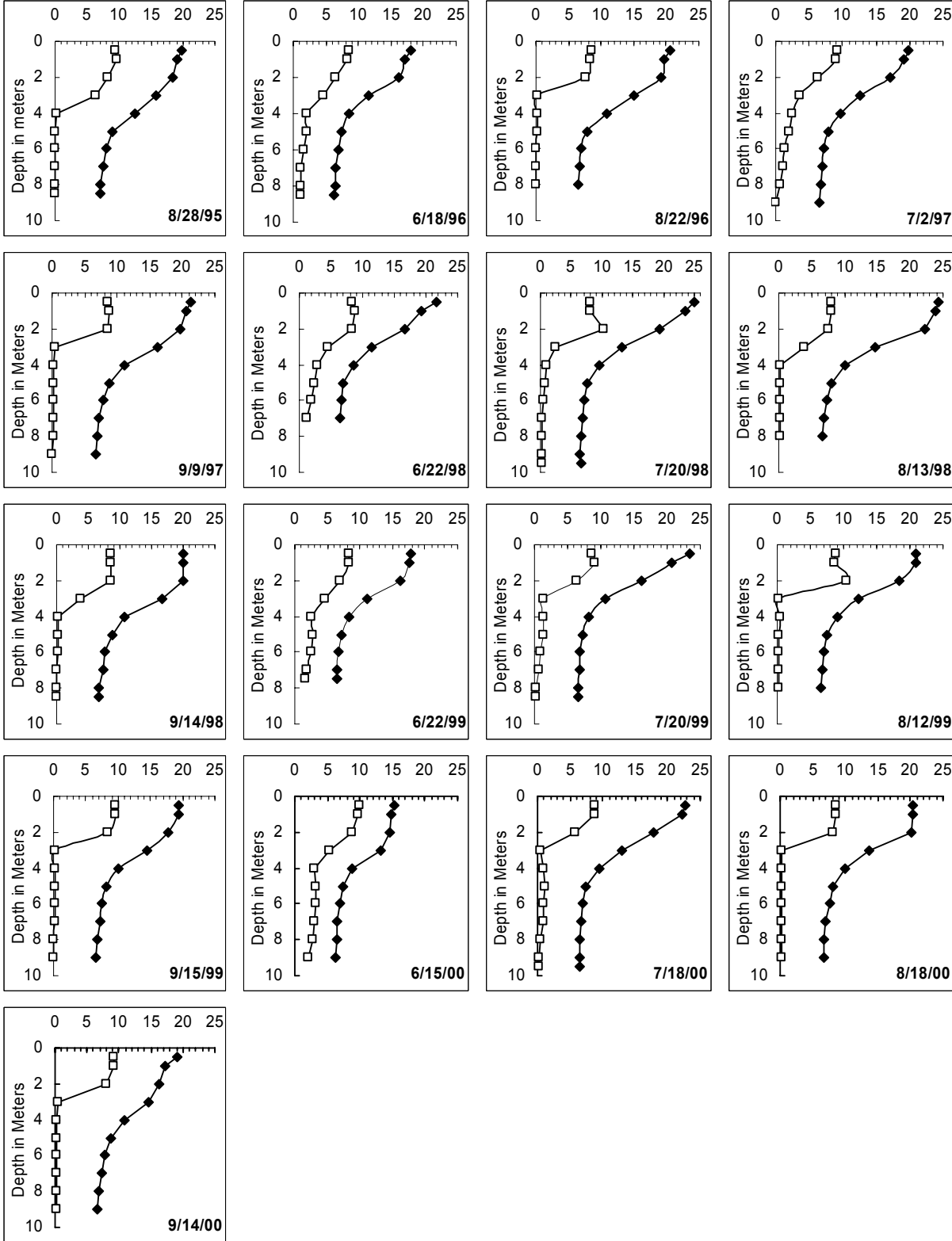
# WATER CLARITY



## TREND ANALYSIS

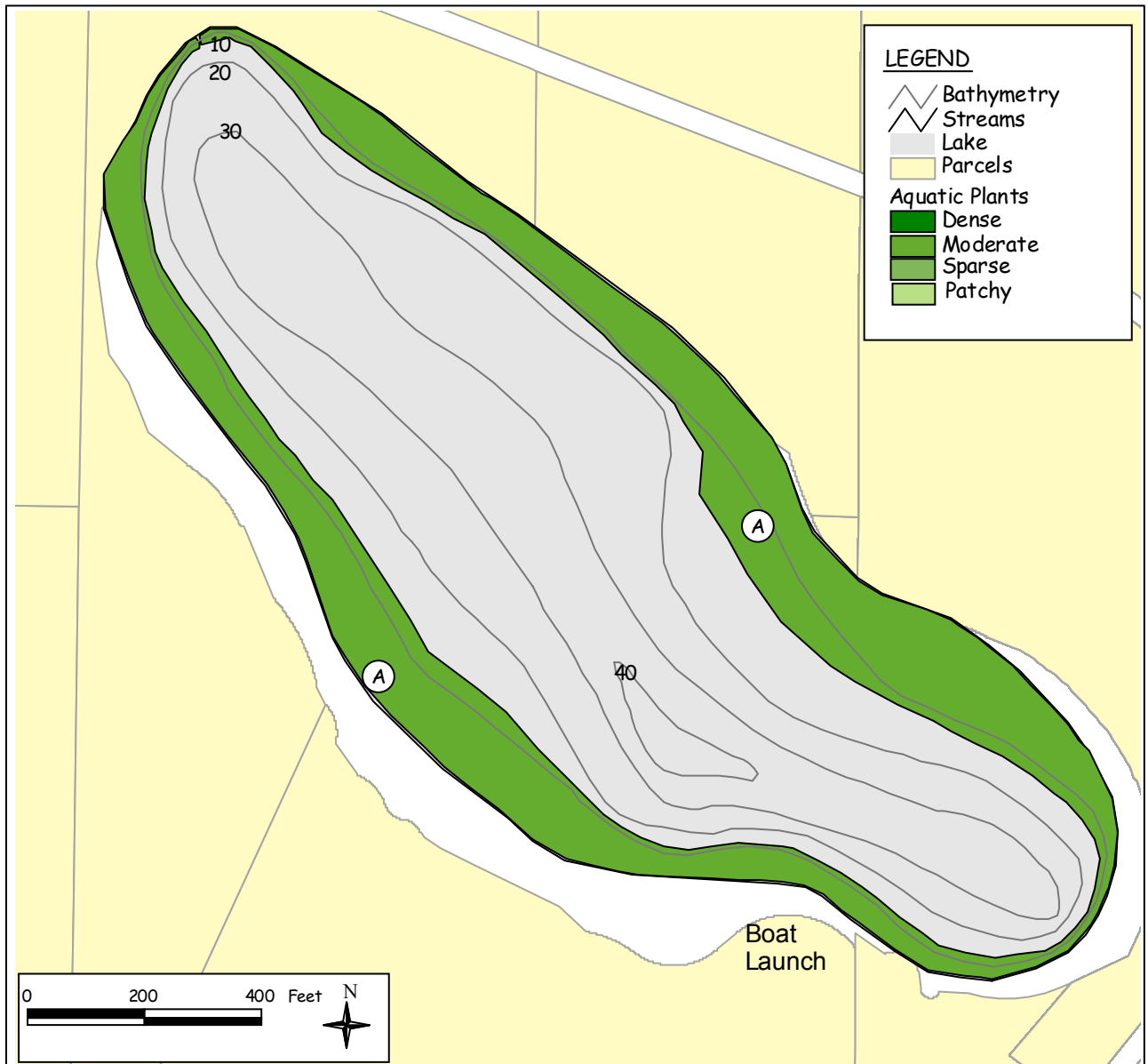


# **DISSOLVED OXYGEN AND TEMPERATURE PROFILES (SELECTED YEARS)**



DO (mg/l)
 
 Temp (°C)

# AQUATIC PLANTS



Area	Density	Dominant Plants	Other Plants
A	Moderate	<i>Brasenia schreberi</i> (Water shield) <i>Potamogeton sp.</i> (Thin-leaf pondweed)	<i>Utricularia vulgaris</i> (Common bladderwort) <i>Myriophyllum hippuroides</i> (Native water-milfoil) <i>Nitella sp.</i> (Brittlewort) <i>Elodea canadensis</i> (Common elodea) <i>Potamogeton epiphydrus</i> (Ribbon-leaf pondweed) <i>Nuphar polysepalum</i> (Yellow water-lily)

Note: Most of the shoreline is bordered by dense wetlands. Douglas spiraea, willow, *Drosera sp.* (Sundew), *Ledum glandulosum* (Labrador tea), *Menyanthes trifoliata* (Bog bean), and *Dulichium arundinaceum* (Three-way sedge) are common around the shoreline.

## **BASIC MONITORING DATA**

1995									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
6/16/1995	1.7	19	19.5	12	90	light	calm	lt brown	Slight algae, moderate aquatic plants. 4 ducks/geese.
7/4/1995	2.0	22	20.5		90	light	calm	lt brown	Slight algae, scum. Moderate aquatic plants.
*08/28/95	2.2				90	none	light	lt brown	H <sub>2</sub> S smell at 8m. Algae very small (looks like mist).
9/9/1995	2.2	21.5	20.5	12	0	none	calm	lt brown	Slight algae in water.
9/24/1995		22	19	13	0	none	calm	lt brown	3 ducks/geese. Moderate algae.
10/8/1995	1.3	14.5	15	7.5	75	moderate	calm	grn brown	Moderate algae. 5 ducks/geese. Floating logs, fish jumping. Oil sheen near edge in SW part. Great blue herons, western grebes spotted.
10/22/1995	1.5	12	12.5		25	moderate	calm	lt brown	5 ducks/geese. Marker for lake level has been moved.

1996									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
5/19/1996	1.6	13.5	14		100	heavy	calm	lt brown	5 ducks and/or geese. Slight algae, no algae scum, plants, odor.
6/2/1996	1.6	28	20	-14.5	10	trace	light	lt brown	Slight algae, no scum, plants, odor.
6/17/1996	2.1	16	18	-17	90	trace	calm	lt brown	No scum, plants, odor, slight algae. 5 ducks and/or geese.
*06/18/96	2.0				100	light	calm	yelbrown	
6/29/1996	1.9	19	19.5	15	25	moderate	calm	lt brown	No scum, odor, slight algae, moderate plants. Now including all the plants around the edge of the lake. There are plenty.
7/13/1996	2.1	29	25.5	13	0	none	calm	lt brown	No scum, odor, slight algae, moderate plants.
7/29/1996	1.9	29	26	14	0	none	calm	lt brown	
8/12/1996	1.9	28	25	14	0	none	calm		
*08/22/96	2.5				0	none	calm	medbrown	
8/25/1996	1.9	29	23		10	none	calm	lt brown	Slight algae, no scum, moderate plants, no odor.
9/8/1996	1.9	17	18		100	heavy	breezy	dk brown	
9/22/1996	1.5	20	17		75	moderate	calm	lt brown	

1997									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
6/28/1997	1.9	25	19.5		25	trace	light	yelbrown	Slight algae, plants.
*07/02/97	2.1				10	trace	light	dk brown	
7/13/1997	1.6	24	21		10	none	calm	yelbrown	moderate algae, slight plants.
7/27/1997	2.0	27	25		0	none	calm	yelbrown	Slight algae, plants. 10 ducks/geese. beer cans, 6-pack rings & other garbage at boat launch.
8/11/1997	1.5	29	26		0	none	light	yelbrown	Slight aquatic plants.
*09/09/97	2.5				0	none	light	medbrown	Coontail, brasenia.

\*Indicates data collected by Snohomish County staff.

1998									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
6/7/1998	1.7	28	22		10	none	light	dk.brown	No scum, aquatic plants or odor; moderate algae; no ducks/geese; water marker to measure lake level missing.
6/20/1998	1.5	24	19		25	trace	calm	dk.brown	No algae, scum or odor; slight aquatic plants; no ducks/geese.
*6/22/98	2.3				10	none	light	dk brown	No ducks/geese, scum; slight plants, algae.
7/4/1998	1.5	18	21		100	moderate	light	dk.brown	Slight algae & plants; no scum or odor; no ducks/geese.
7/19/1998	1.9	22	23.5		90	none	light	lt brown	No algae, scum or odor; bulrush around edge; no ducks/geese.
*7/21/98	1.9				0	none	light	goldbrown	No ducks/geese, scum, odor; slight plants, algae.
8/1/1998	2.2	24.5	24		100	trace	light	lt brown	No algae, scum or odor; normal riparian plants (Bulrush, etc.); no ducks/geese.
*8/13/98	2.8				0	none	calm	goldbrown	No ducks/geese, scum; slight plants (elodea, brasenia), odor in bottom sample; moderate algae. Heard bullfrog.
8/16/1998	1.8	18.5	23.5		75	light	light	lt brown	No algae, scum or odor; moderate plants; no ducks/geese.
8/31/1998	1.8	26	23.5		0	none	calm	dk brown	Slight algae, plants. No scum, odor, ducks/geese.
*9/14/98	2.9				10	none	calm	dk brown	No ducks/geese, scum; slight plants, algae; moderate odor in bottom sample.
9/26/1998	1.8	22	19		0	moderate	calm	lt brown	No algae, scum, or odor. Slight aquatic plants. No ducks/geese.

1999									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
*6/22/99	1.9	14	17.8		100	moderate	calm	dk brown	
*7/20/99	2.1	28	23.5		0	none	calm	dk brown	
*8/12/99	1.9	15	21		100	trace		dk brown	
*9/15/99	1.6	16	19.5		10	none	light	dk brown	Moderate odor from bottom sample.

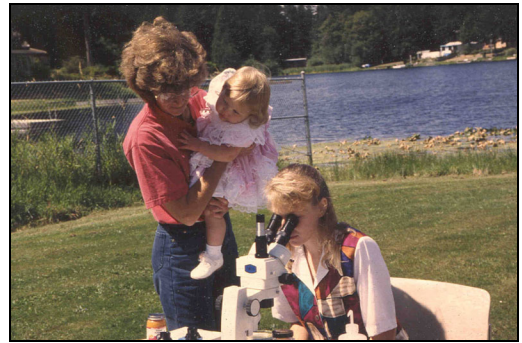
## 2000

DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
*04/24/00	2.4	11.6	12.1		100	moderate	calm	dk brown	depth at station = 9.2m 1 duck and no algae or algae scum.
5/12/2000	2.2	17	13.2		10	heavy	calm	dk brown	No ducks or algae scum, and slight algae.
5/24/2000	2.2	18	20		10	light	calm	dk brown	Clean lake. 20 ducks and no algae, algae scum, or aquatic plants.
6/8/2000	2.1	13.5	16.5		100	moderate	calm	dk brown	1 duck and no algae, algae scum, or aquatic plants.
*06/15/00	1.6	15	15.18		90	moderate	light	dk brown	Lots of zooplankton. Saw hummingbird and small muskrat(?). 1 duck, moderate algae, no algae scum, and slight aquatic plants.
6/20/2000	1.5	24	20		10	light	light	dk brown	Clean lake. No ducks, algae, algae scum, or aquatic plants.
7/14/2000	2	18	22		10	none	calm	dk brown	No ducks, algae, algae scum, or aquatic plants.
*07/18/00	1.9	20	22.66		25	none	breezy	dk brown	No ducks or algae scum, moderate algae, and slight aquatic plants.
7/26/2000	1.8	20	22		100	light	calm	dk brown	Clean lake. 2 ducks and no algae, algae scum, or aquatic plants.
8/13/2000	2	20	23		10	none		dk brown	2 ducks and no algae, algae scum, or aquatic plants.
*08/18/00	1.8	15	20.34		100	light	calm	dk brown	1 duck, slight algae, no algae scum, and moderate aquatic plants.
9/12/2000	2	20	18		50	heavy	light	dk brown	2 ducks, no algae or algae scum, and slight aquatic plants.
*09/14/00	2	21	19.06		0	none	calm	dk brown	1 duck, slight algae and aquatic plants, and no algae scum.
10/7/2000	2	19	15		90	none	calm	dk brown	Clean. No algae, algae scum, or aquatic plants.

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

## ***HOW YOU CAN HELP LAKE RILEY***

- 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 Riley.

(TTY users call 425-388-3700)

