

Chain Lake

Chain Lake has moderate water clarity, high nutrient levels, and moderate to high levels of plants and algae. However, the lake appears to be in healthy condition for a shallow, wetland lake. The future health of the lake depends on controlling the impacts of any new development around the shoreline and in the watershed.

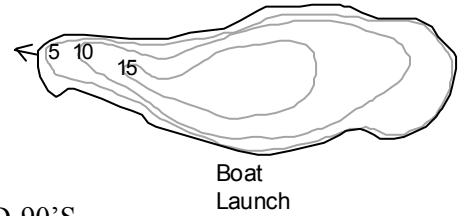


State of the Lakes Report
March 2003

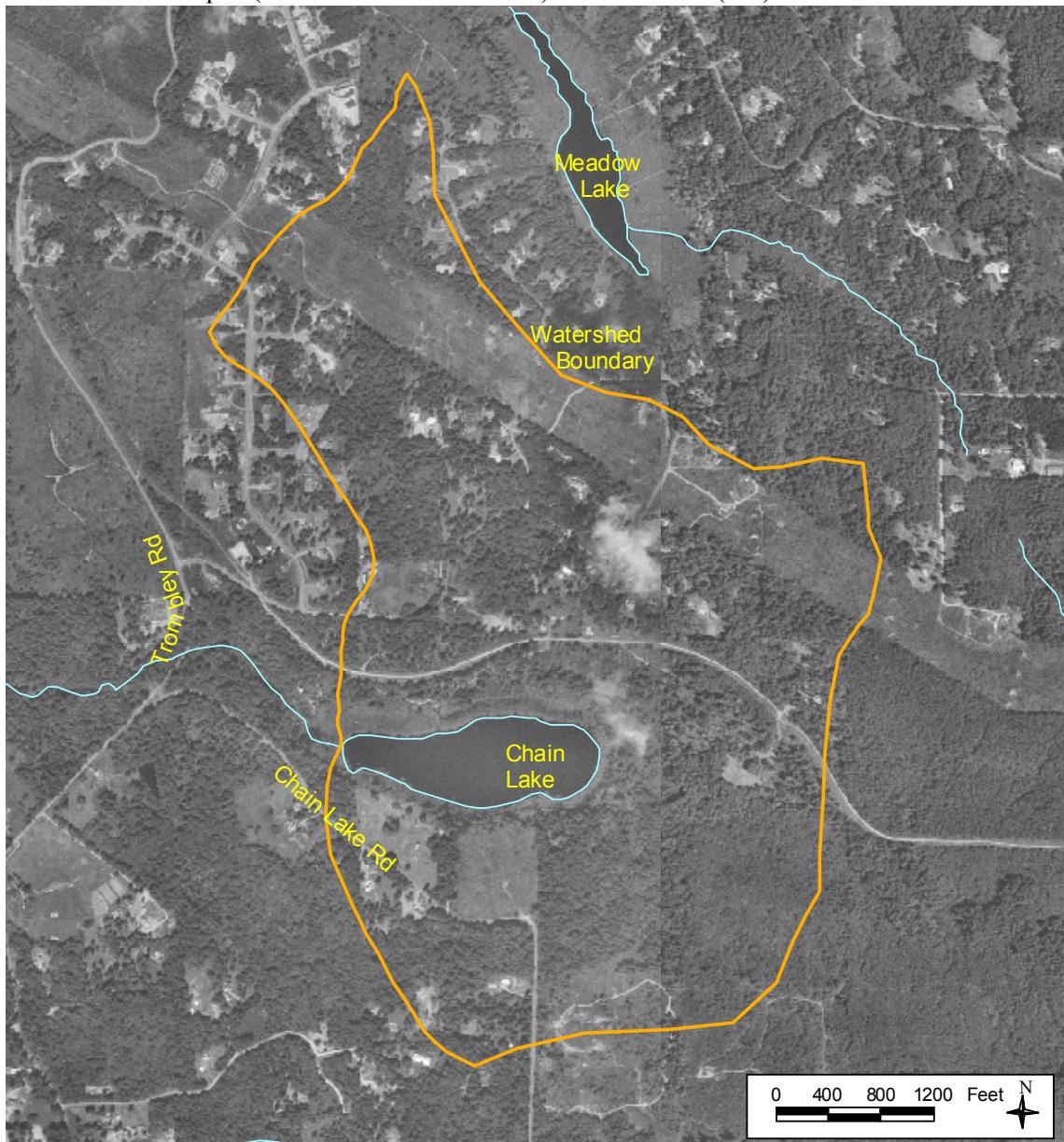
Snohomish County Public Works
Surface Water Management

LAKE AND WATERSHED DATA

Lake Area: 21 acres
 Watershed Area: 472 acres
 Watershed to Lake Area Ratio: 22.2
 Maximum Depth: 18 feet (5.5 meters)
 Average Depth: 10 feet (3.0 meters)
 Lake Volume: 210 acre-feet
 Length of Shore: 0.8 miles



	<u>1973</u>	<u>MID-90'S</u>
# of nearshore homes	3	3
# of homes/1000' of shoreline	0.7	0.7
% of homes with bulkhead or fill		0%
% of homes with some native vegetation near shore		100%
% of watershed developed (residential or commercial)	0%	5% (est.)



LAKE ASSESSMENT

DESCRIPTION

■ **Location/Access**– Chain Lake is located approximately three miles north of Monroe. The lake is fed by small seasonal streams, and drains westward to French Creek and eventually the Snohomish River. There is a primitive public boat launch located on the south side of the lake operated by the Department of Fish and Wildlife. Gas-powered boats are not permitted on the lake.

■ **Size/Shape**– Chain Lake is a small, shallow bog lake. It is 21 acres in size with a maximum depth of 5.5 meters and an average depth of 3.0 meters. The lake volume contains 210 acre-feet of water.

■ **Watershed**– The watershed, including the lake, covers 472 acres, which is 22.2 times the size of the lake. This is one of the larger watershed to lake area ratios in Snohomish County and means that there is a potential for negative impacts to the lake from pollution coming from the watershed. In 1973, the watershed was virtually undeveloped, with approximately 19% of the land used for agricultural purposes and the remainder forested or undeveloped. By the mid-1990s, several dozen homes had been added in the watershed and additional building sites cleared, bringing the developed total to about 5% of the watershed. There is a high potential for significant new development in the watershed because the lake is located on the fringe of the growing Monroe area.

■ **Shoreline**– The shoreline of Chain Lake is 0.8 miles in length. Wetlands surround much of the lake, providing valuable fish and wildlife habitat and keeping most of the shoreline undeveloped. There were only three nearshore homes in 1973, and the same number in the mid-90s. None of the shoreline is modified with bulkheads or fill, and all of the homes have left native vegetation near shore. In 1996, a large parcel of land near the lake was logged, indicating that development near the shoreline may soon be increasing.



LAKE CONDITIONS

■ **Water Clarity**– Average summer water clarity in Chain Lake ranged from 2.0 to 4.0 meters between 1993 and 2002, with a long-term average of 3.1 meters. During the period from 1995 to 1998, the water clarity average dropped below 3.0 meters. However, clarity has improved again in recent years.

■ **Color**– The lake water is moderately colored by dissolved organic (humic) material from the lake sediments and surrounding wetlands, making the water greenish-brown to medium brown.

■ **Nutrients**– Summer average total phosphorus concentrations in the epilimnion ranged from 12 to 28 $\mu\text{g/l}$ between 1996 and 2002, which is moderately high for Snohomish County lakes. One sample in 1973 showed a higher value. Total phosphorus averages in the hypolimnion were even higher, ranging from 35 to 84 $\mu\text{g/l}$ from 1996 to 2002. This suggests a substantial release of phosphorus from the bottom sediments during times of oxygen depletion. Total nitrogen levels measured in 1973 were fairly low (340 $\mu\text{g/l}$ in the epilimnion), indicating that nitrogen levels at that time may have been low enough to limit algal growth.

■ **Alkalinity**– Limited data from 1994 and 1995 indicate that Chain Lake has a low buffering capacity and is sensitive to nutrient pollution.

■ ***Oxygen/Temperature*** – Vertical profiles of dissolved oxygen and temperature for the summers of 1995 through 2002 show moderately 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 in the water below about 3 or 4 meters by mid to late summer. On a number of occasions, there were spikes in dissolved oxygen at 2 to 3 meters depth, suggesting vigorous algal growth at this level. During the summer of 2001, zooplankton (microscopic animals) were so dense that they reduced the dissolved oxygen levels even near the surface.

■ ***Algae*** – Limited chlorophyll *a* samples taken during the summers of 1994, 1995, and 2002 had values ranging from 1.9 to 14 µg/l. The higher values indicate that the lake is capable of producing substantial amounts of algae. Analysis of algae samples collected in 1994-95 revealed that blue-green algae were dominant in one sample. The other samples showed a more diverse algae community.

■ ***Aquatic Plants*** – Rich bottom sediments, coupled with a large shallow zone, provide good habitat for aquatic plants to grow. Moderate to dense concentrations of aquatic plants cover much of the lake bottom. The dominant plants are natives, including elodea, coontail, and yellow water-lily.

■ ***Other Lake Life*** – In some years, especially 1995, many large bryozoans have been observed in Chain Lake growing on underwater tree limbs and plant stems. Bryozoans are jelly-like, colonial, filter-feeding animals that are indicators of good water quality.

SUMMARY

■ ***Trophic State*** – Based on moderate water clarity, elevated phosphorus concentrations, and moderate to high levels of plants and algae, Chain Lake may be classified as meso-eutrophic.

■ ***Current Conditions/Trends*** – Chain Lake is currently in healthy condition for a meso-eutrophic

lake. Monitoring data have not revealed any statistically significant trends in water quality during the 1990s.

■ ***Future Concerns/Targets*** – The main concern for Chain Lake is the high potential for increasing development in the watershed and near the lake shore which could introduce new sources of nutrients to the lake. If this occurs, it would accelerate the process of eutrophication and make blue-green algal blooms more frequent. Maintaining the current water clarity and phosphorus levels is the target for the lake.

■ ***Recommendations*** – The lake should be monitored carefully to track any changes to water clarity, nutrient levels, and algal blooms. Wetlands surrounding the lake should be protected to filter pollution and provide fish and wildlife habitat. New development in the watershed should take precautions to control runoff and reduce nutrient pollution.

CITIZEN VOLUNTEERS

Thanks to Brian Vanover, Mike Manson, Laura Reed, and Travis Powell for volunteer monitoring of Chain Lake.

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	7/23/73	1.8	33	30	10	-
Volunteer	Summer 1993	2.0 - 4.1 (3.0) n = 6	-	-	-	-
SWM Staff	Summer 1994	3.5 - 4.3 (4.0) n = 3	-	-	20 - 30 (25) n = 2	2.8 - 13 (7.9) n = 2
SWM Staff	Summer 1995	2.5	-	-	30	14
SWM Staff or Volunteer	Summer 1996	2.3 - 2.5 (2.4) n = 3	8 - 16 (12) n = 2	48 - 119 (84) n = 2	-	-
SWM Staff	Summer 1997	2.2 - 3.1 (2.6) n = 2	15 - 40 (28) n = 2	21 - 49 (35) n = 2	-	-
SWM Staff or Volunteer	Summer 1998	1.4 - 2.6 (2.0) n = 6	10 - 24 (17) n = 4	33 - 46 (38) n = 4	-	-
SWM Staff or Volunteer	Summer 1999	2.8 - 4.3 (3.5) n = 12	11 - 25 (18) n = 4	48 - 76 (64) n = 4	-	-
SWM Staff or Volunteer	Summer 2000	2.3 - 4.3 (3.3) n = 10	11 - 22 (16) n = 4	26 - 111 (57) n = 4	-	-
SWM Staff	Summer 2001	2.9 - 3.8 (3.5) n = 4	12 - 19 (16) n = 4	26 - 92 (59) n = 4	-	-
SWM Staff	Summer 2002	3.4 - 4.3 (3.9) n = 4	10 - 21 (14) n = 4	25 - 85 (45) n = 4	-	1.9 - 5.1 (3.0) 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 0.34 mg/l in the epilimnion and 0.35 mg/l in the hypolimnion; which suggests that nitrogen levels may have been low enough to limit algal growth.

■ **Alkalinity** – limited data from 1994 and 1995 ranged from 15 -- 23 mg/l CaCO₃, which suggests that Chain has a low buffering capacity and is sensitive to nutrient pollution.

■ **pH** – readings from 1994 through 2000 averaged 6.9 near the surface and 6.0 near the bottom, which is within the normal range for Snohomish County lakes. 2001-2002 readings were similar.

■ **Conductivity** – 1994-2000 data averaged 39 µmhos in the epilimnion and 107 µmhos near the lake bottom, indicating moderate levels of dissolved materials in the water. Data from 2001-2002 were similar.

■ **Iron** – limited 1994-95 data showed high levels in the epilimnion (avg. 115 µg/l) and higher levels in the hypolimnion (avg. 600 µg/l, high of 890 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 volume was high in one sample and that blue-greens, cryptomonads, and dinoflagellates were each most prevalent at times. Cell counts of the same

samples revealed that blue-green algae were most abundant, ranging from 38% to 88%.

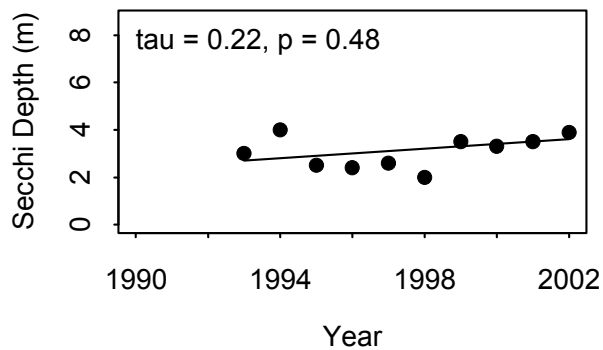
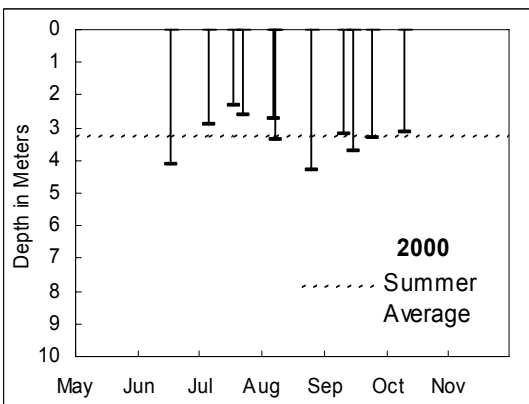
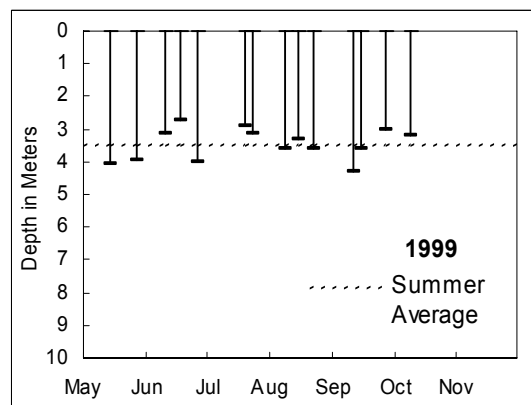
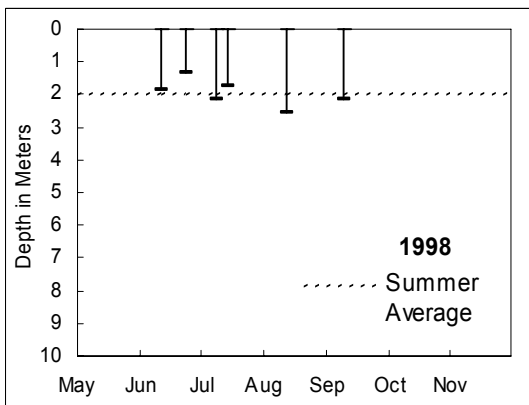
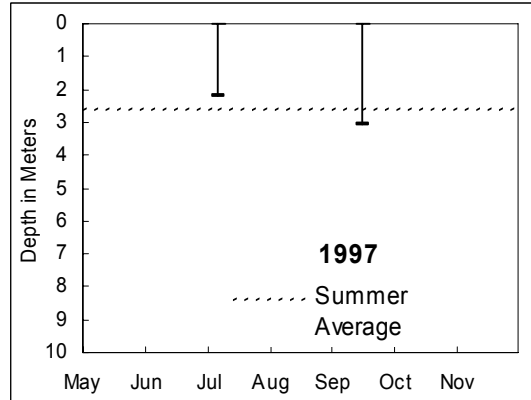
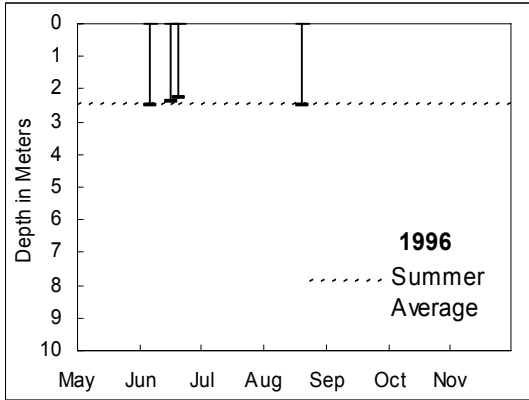
ALGAE TYPES	7/15/94	9/12/94	8/16/95
Cyanophyta (Blue-greens)	13%	3%	89%
Chlorophyta (Greens)	0%	6%	4%
Chrysophyta (Golden/diatoms)	20%	3%	1%
Cryptophyta (Cryptomonads)	27%	66%	4%
Euglenophyta (Euglenoids)	0%	15%	1%
Pyrrhophyta (Dinoflagellates)	41%	7%	2%
TOTAL BIOVOLUME (mm ³ /l)	0.696	0.82	3.55

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

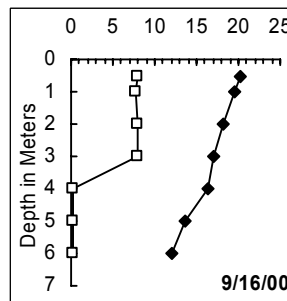
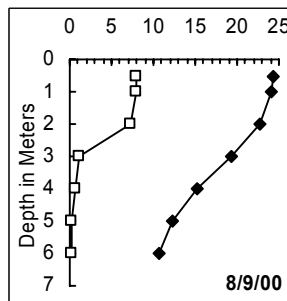
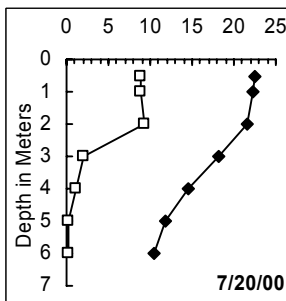
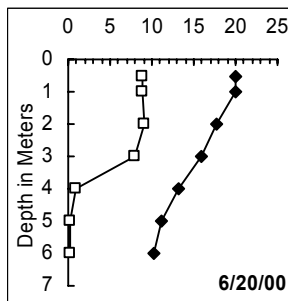
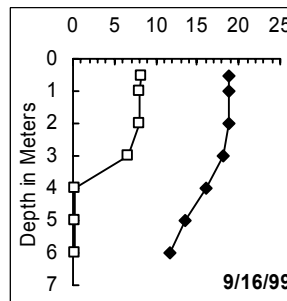
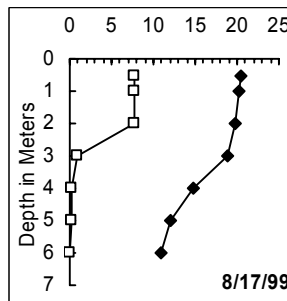
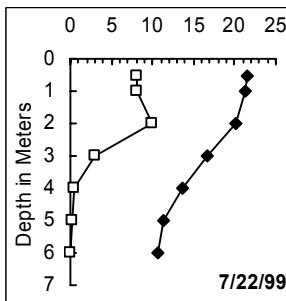
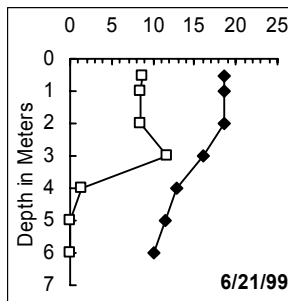
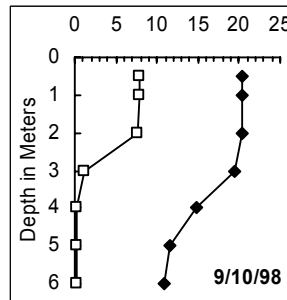
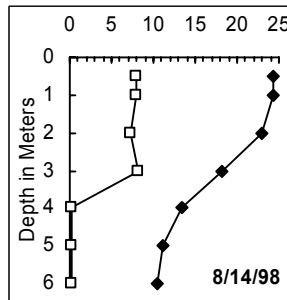
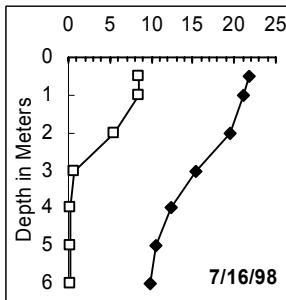
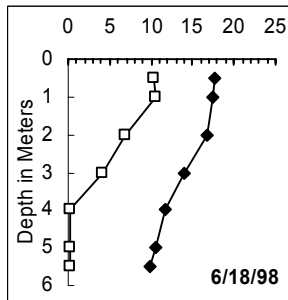
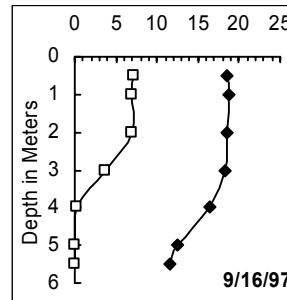
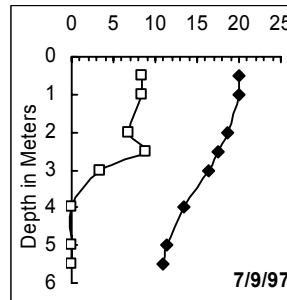
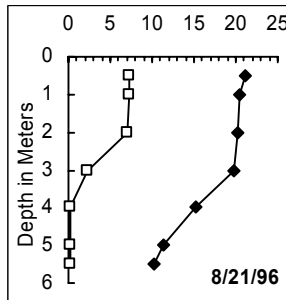
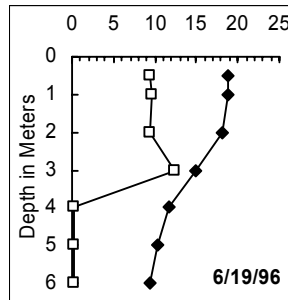
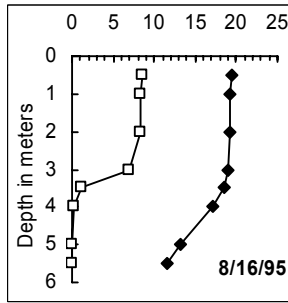
DATA SOURCES

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

WATER CLARITY

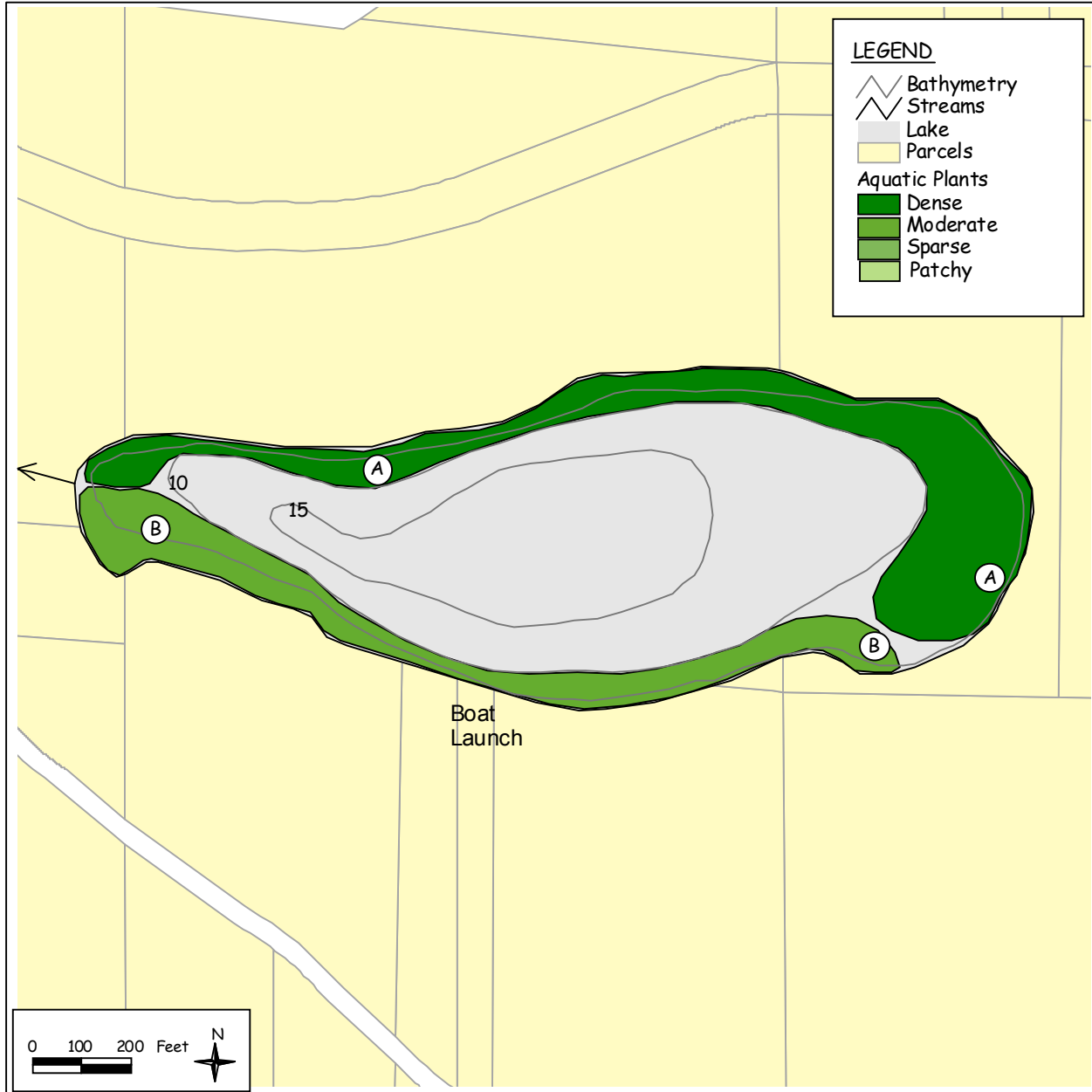


DISSOLVED OXYGEN AND TEMPERATURE PROFILES (SELECTED YEARS)



—□— DO (mg/l) —◆— Temp (°C)

AQUATIC PLANTS



Area	Density	Dominant Plants	Other Plants
A	Dense	<i>Elodea canadensis</i> (Common elodea) <i>Ceratophyllum demersum</i> (Coontail) <i>Nuphar polysepalum</i> (Yellow water-lily)	<i>Potamogeton amplifolius</i> (Large-leaf pondweed) <i>Nitella sp.</i> (Brittlewort) <i>Potamogeton sp.</i> (Thin-leaf pondweed) <i>Lemna minor</i> (Common duckweed)
B	Moderate	<i>Elodea canadensis</i> (Common elodea) <i>Ceratophyllum demersum</i> (Coontail)	<i>Nuphar polysepalum</i> (Yellow water-lily) <i>Potamogeton sp.</i> (Thin-leaf pondweed) <i>Nitella sp.</i> (Brittlewort)

BASIC MONITORING DATA

1995									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
*08/16/95	2.5				75	moderate	calm	medgreen	Aquatic plants primarily along N shore. Algae were short and threadlike (Aphanizomenon?). Lots of phantom midges, and daphnia seen from surface. Oil-like scum collecting pollen and other particulates at outlet and along W. side of southern shoreline.

1996									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
6/9/96	2.5	18.5	19.75	8.3	75	trace	light	ltgreen	5 fishing boats, 3 clumps yellow Iris-3 places on lake, recent logging on S. side of lake 15-20 acres. No algae, scum, odor, heavy plants at edge.
*06/19/96	2.4				0	light	strong	grnbrown	Odor - med to strong H2S at 5m. Large clumps of spirogyra near shore. No bryozoans (compare to '95). 5 acre parcel just east of boat ramp logged recently (clear cut) about 50' buffer left by lake.
6/23/96	2.3	18	19.5	8.7	90	light	strong	grnbrown	4 boats-fishing. No algae, scum, odor, heavy plants.
*08/21/96	2.6				0	trace	light	medbrown	algae - sticklike - maybe aphanizomenon.

1997									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
*07/09/97	2.2				100	mod	light	medbrown	
*09/16/97	3.1				100	mod	light	medbrown	

1998									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
6/14/98	1.9	15	19.25	8.58	100	trace	breezy	lt brown	No algae, scum or odor; moderate aquatic plants; 5 ducks/geese; new marker.
*6/26/98	1.4				100	light	light	medbrown	No ducks/geese, scum; moderate algae.
7/11/98	2.2	15.07	20	9.36	90	trace		grnbrown	No algae, scum or odor; heavy plants at edge; no ducks/geese
*7/16/98	1.8				100	light	light	medbrown	No ducks/geese, odor; slight plants, algae.
*8/14/98	2.6				0	none	light	goldbrown	No odor, scum; slight plants, algae. 6 ducks.
*9/10/98	2.2				0	none	calm	yelbrown	4 ducks. Slight scum, plants, odor at 4.5 m; moderate algae.

*Indicates data collected by Snohomish County staff.

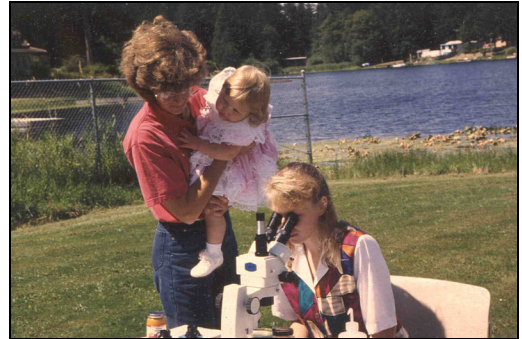
1999									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
5/31/99	4.0	14	18	19.5	100	light	light	lt green	
6/13/99	3.2	24	20	19.5	75	light	breezy	grnbrown	
*6/21/99	2.8				100	light	light	dk brown	Osprey.
6/29/99	4.0	18	17.5	19.6	100	light	light	grnbrown	
*7/22/99	2.9	20	21.5		25	light	light	dk brown	
7/26/99	3.2	25.5	20	20.5	0	light	breezy	grnbrown	
8/10/99	3.6	24	22	21.5	0	light	light	grnbrown	
*8/17/99	3.3	18	20.38		100	moderate	calm	medbrown	
8/24/99	3.6	21.5	21	21.5	0	none	calm	grnbrown	Trash at boat launch.
9/12/99	4.3	24	19.5	25.5	0	none	breezy	grnbrown	
*9/16/99	3.6	15			100	none	light	medbrown	Slight musty odor. Lots of zooplankton.
9/28/99	3.1	24	16	23.8	10	light	light	grnbrown	
10/10/99	3.2	9	13	24.5	25	light	breezy	grnbrown	

2000									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
*06/20/00	4.1	22	20.07		0	none	light	medgrnbrn	Good clarity. Plants healthy - nuphar, elodea, floating-leaf? p.w., chara, vallisneria, thin-leaf? p.w. 4 ducks, moderate algae and aquatic plants, and no algae scum.
7/8/00	3.0	20	21.5	22	100	none	breezy	gr-brown	depth=6.1m 3 ducks, moderate algae and aquatic plants, slight algae scum.
*07/20/00	2.3	21	22.57		100	none	calm	dk brown	Moderate algae, no algae scum, and slight aquatic plants.
7/25/00	2.6	24	22	22	50	none	light	gr-brown	20 ducks, moderate algae and aquatic plants, and slight algae scum.
8/8/00	2.8	20	21.5	22	50	none	light	gr-brown	30 ducks, moderate algae and algae scum, and heavy aquatic plants.
*08/09/00	3.4	25	24.22		0	none	light	dk brown	No ducks, moderate algae, no algae scum, and slight aquatic plants.
8/27/00	4.4	16	20	25	50	light	light	gr-brown	Trash at boat launch. 12 ducks, moderate algae, slight algae scum, and heavy aquatic plants.
9/11/00	3.2	15	18.5	26	25	none	light	gr-brown	26 ducks, slight algae and algae scum, and moderate aquatic plants.
*09/16/00	3.7	24	20.18		25	none	light	medyelbrn	1 duck, slight algae and aquatic plants, and no algae scum.
9/25/00	3.4	14.5	18	26.3	100	light	breezy	gr-brown	12 ducks, slight algae and algae scum, and moderate aquatic plants.
10/11/00	3.2	14	16.5	27	100	light	light	gr-brown	6 ducks, slight algae and aquatic plants, and no algae scum.

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

HOW YOU CAN HELP CHAIN LAKE

- 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 Chain Lake.

(TTY users call 425-388-3700)