

Meadow Lake

Meadow Lake is a unique bog lake with low water clarity, high nutrient levels, and abundant aquatic plants. Maintaining lake water quality depends on protecting the surrounding wetlands and controlling nutrient runoff from potential future development in the lake's large watershed. The spread of an invasive aquatic plant, European frog-bit, is a threat to the lake.

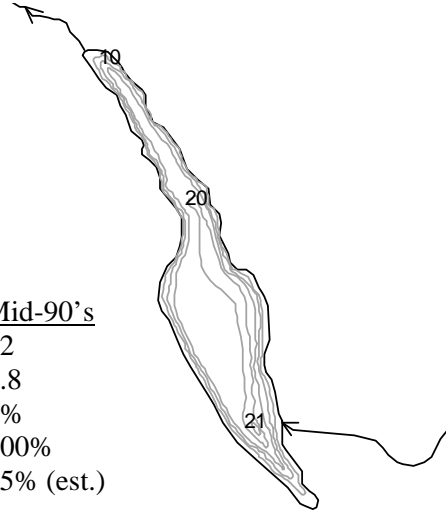


State of the Lakes Report
March 2003

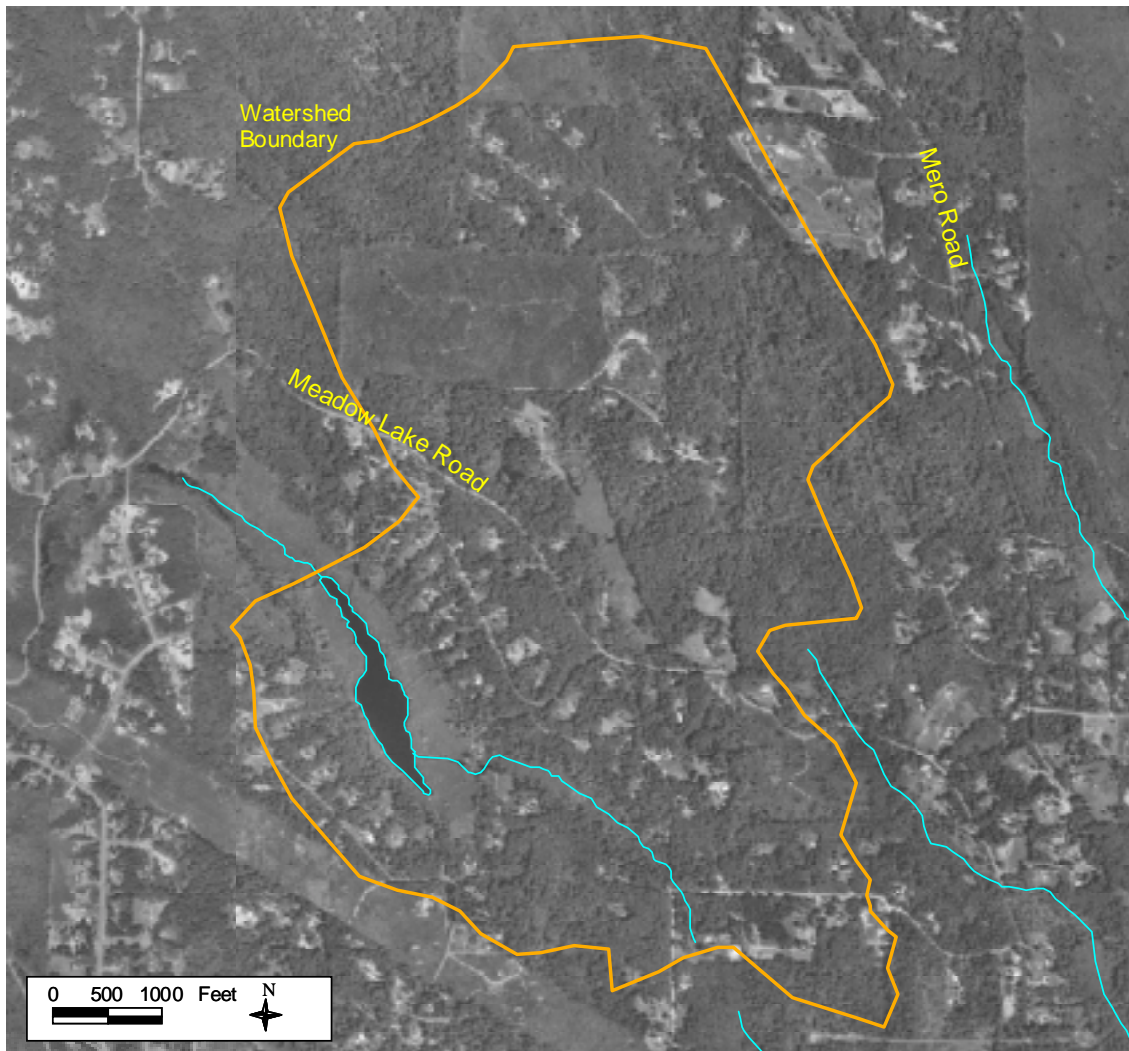
Snohomish County Public Works
Surface Water Management

LAKE AND WATERSHED DATA

Lake Area: 12 acres
 Watershed Area: 868 acres
 Watershed to Lake Area Ratio: 72.3
 Maximum Depth: 21 feet (6.4 meters)
 Average Depth: 14 feet (4.3 meters)
 Lake Volume: 170 acre-feet
 Length of Shore: 1.1 miles



	<u>1974</u>	<u>Mid-90's</u>
# of nearshore homes	0	22
# of homes/1000' of shoreline	0	3.8
% of homes with bulkhead or fill		0%
% of homes with some native vegetation near shore		100%
% of watershed developed (residential or commercial)	<5%	15% (est.)



LAKE ASSESSMENT

DESCRIPTION

■ Location/Access – Meadow Lake is a bog lake located about 4 miles north of Monroe. Ghost Horse Creek, an intermittent stream, feeds the lake. In turn, Meadow Lake drains through a series of wetlands and beaver ponds to French Creek, which flows into the Snohomish River. Meadow Lake has no public access.

■ Size/Shape – The surface area of Meadow Lake covers 12 acres. The lake has a maximum depth of 6.4 meters, an average depth of 4.3 meters; and a volume of 170 acre-feet, making it one of the smaller lakes in the county.

■ Watershed – In contrast to its small surface area, Meadow Lake has a large watershed, which totals 868 acres, including the lake. The ratio of the watershed to lake area is 72.3. Having a large watershed means that there is greater potential for receiving pollution and sediment from the surrounding lands than at a lake with a small watershed. However, the Meadow Lake watershed is still relatively undeveloped. In 1974, less than 5% of the watershed was developed with residential or commercial uses. By the mid-90s, development covered only about 15% of the watershed.

■ Shoreline – The shoreline of Meadow Lake is 1.1 miles long. There were no houses around the shore in 1974. However, by the mid-90s, there were 22 homes on the lake. Because of dense wetlands surrounding the lake, all of the homes are set back from the shore, and there are no bulkheads or fill. These shoreline wetlands are important for filtering pollution before it reaches the water.

LAKE CONDITIONS

■ Water Clarity – The water clarity of Meadow Lake is low. From 1993 to 2002, summer water clarity averages were fairly consistent, ranging from 0.9 to 1.2 meters. The greatest individual measurement during this period was 1.4 meters in 1994. A single reading in 1981 showed 0.9 meters.



■ Color – The lake water is darkly colored by dissolved organic (humic) material from the surrounding wetlands. This is a major factor limiting water clarity. Although there have been no measurements of water color, monitors usually describe the water as brown.

■ Nutrients – Only limited nutrient data are available for Meadow Lake. Total phosphorus concentrations were 20 $\mu\text{g/l}$ in the epilimnion and 10 $\mu\text{g/l}$ in the hypolimnion in 1981. In contrast, single 1997 and 1999 samples had much higher concentrations—64 and 59 $\mu\text{g/l}$ in the epilimnion and 53 and 44 $\mu\text{g/l}$ in the hypolimnion. Four samples in 2002 were similar, averaging 50 $\mu\text{g/l}$ in the epilimnion and 63 $\mu\text{g/l}$ in the hypolimnion. Many of the samples through the years have shown lower concentrations in the hypolimnion than near the surface. This is unusual for stratified lakes, but may indicate that the humic compounds that give the water its dark color also cause phosphorus to drop out of suspension when it reaches the oxygen-depleted lower waters. The total nitrogen concentration measured in a single 1981 sample was fairly high at 1,100 $\mu\text{g/l}$, which suggests that nitrogen was available and not limiting algal growth.

■ Oxygen/Temperature – Vertical profiles of dissolved oxygen and temperature measured once in both 1997 and 1999 show strong stratification between the warm, oxygenated upper waters and

cool, oxygen-depleted bottom waters. Dissolved oxygen was totally depleted below 2 or 3 meters. This indicates the presence of significant decaying organic matter in the lake bottom.

- Algae – The only chlorophyll *a* measurement available for Meadow Lake was 9.4 µg/l in 1981, which indicates a high level of algae. Observations by the citizen volunteers through the years have noted slight to moderate levels of algae with occasional algal scums.

- Aquatic Plants – Because the dark water reduces light availability, aquatic plants are restricted to a narrow band of water around the shoreline. Ribbon-leaf pondweed and yellow water-lily, both native aquatic plants, grow densely in the shallow water. In recent years, Meadow Lake has become infested with *Hydrocharis morsus-ranae* (European frog-bit), a small free-floating plant. Much of the shore and some of the surrounding wetlands are now infested with this plant. European frog-bit is on the State Noxious Weed Board’s quarantine list to prohibit its sale, transport, or planting because it has caused serious problems in other parts of North America.

SUMMARY

- Trophic State – Based on low water clarity, high aquatic plant productivity, and limited data showing elevated phosphorus concentrations and a high chlorophyll *a* concentration, Meadow Lake may be classified as eutrophic.

- Current Conditions/Trends – Meadow Lake is in satisfactory condition for a bog lake. However, the spread of European frog-bit makes the lake at risk for future problems that may affect use of the lake.

- Future Concerns/Targets – The main concerns for Meadow Lake are the continued spread of European frog-bit and the potential for water quality impacts if widespread development occurs in such a large watershed. Maintaining the current water clarity and phosphorus levels is the target for the lake.

- Recommendations – New development in the watershed should take precautions to control runoff and reduce nutrient pollution. The wetlands surrounding the lake should be protected to filter pollution and provide fish and wildlife habitat. Monitoring of the lake should continue, with focus on water clarity, nutrients, algae, and aquatic plants. Unfortunately, no management strategies that would eliminate or reduce the European frog-bit are feasible. However, care should be taken to prevent the spread of this plant to other county lakes.

CITIZEN VOLUNTEERS

Thanks to Doug and Robin Schaffer for years of volunteer monitoring at Meadow 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
Sumioka and Dion, 1985	7/7/81	0.9	20	10	-	9.4
Volunteer	Summer 1993	0.7 - 1.1 (0.9) <i>n</i> = 9	-	-	-	-
Volunteer	Summer 1994	1.0 - 1.4 (1.2) <i>n</i> = 6	-	-	-	-
Volunteer	Summer 1995	0.9 - 1.2 (1.0) <i>n</i> = 5	-	-	-	-
Volunteer	Summer 1996	1.0 - 1.4 (1.1) <i>n</i> = 4	-	-	-	-
SWM Staff or Volunteer	Summer 1997	0.8 - 1.1 (0.9) <i>n</i> = 2	64	53	-	-
Volunteer	Summer 1998	0.9 - 1.2 (1.0) <i>n</i> = 4	-	-	-	-
SWM Staff or Volunteer	Summer 1999	0.9 - 1.1 (1.0) <i>n</i> = 3	59	44	-	-
Volunteer	Summer 2000	1.1 (1.1) <i>n</i> = 3	-	-	-	-
Volunteer	Summer 2002	0.8 - 1.3 (1.0) <i>n</i> = 4	35 - 75 (50) <i>n</i> = 4	30 - 128 (63) <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.

SUMMARY OF OTHER DATA

■ Total Nitrogen – single samples in 1981 showed 1.1 mg/l in both the epilimnion and the hypolimnion, which suggests that nitrogen levels were high and not limiting algal growth.

■ pH – from single observations in 1997 and 1999, pH averaged 6.3 near the surface and 5.8 near the bottom, which is more acidic than most Snohomish County lakes.

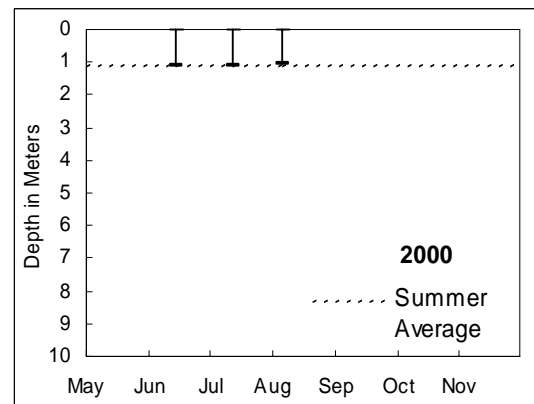
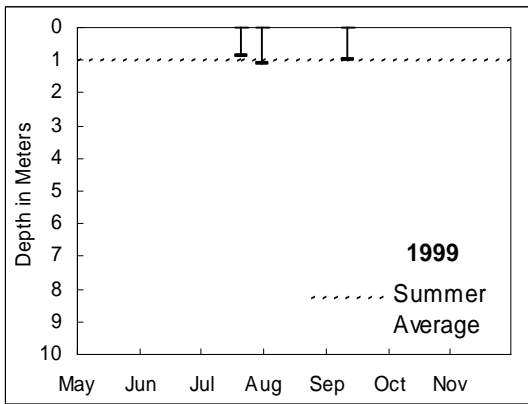
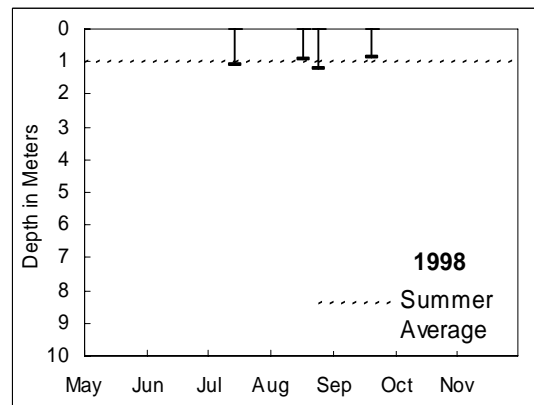
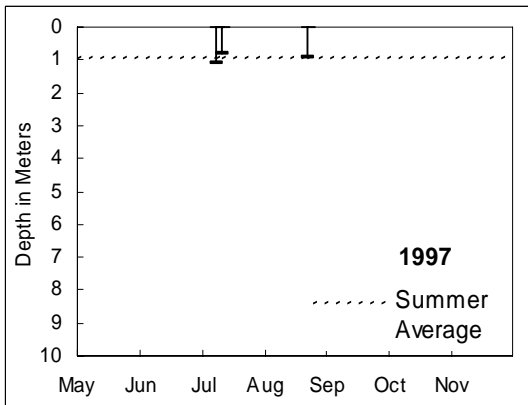
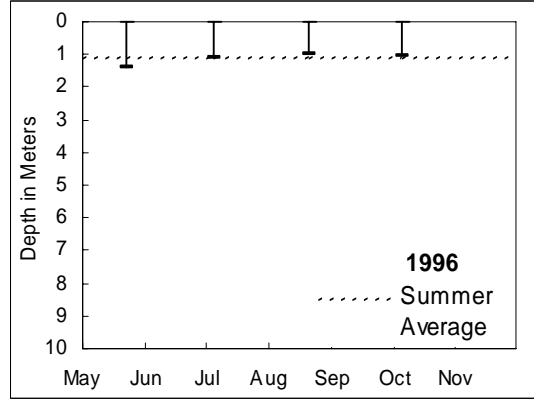
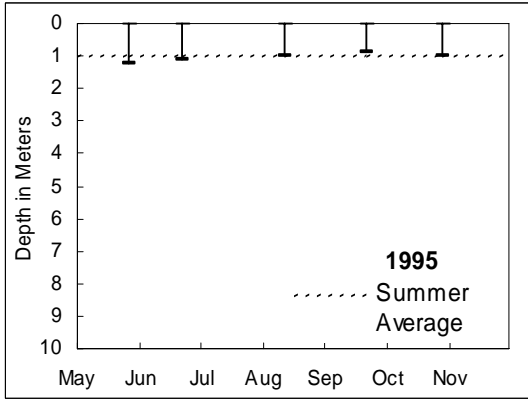
■ Conductivity – single samples in 1999 showed 31 µmhos in the epilimnion and 43 µmhos near the

lake bottom, indicating low levels of dissolved materials in the water.

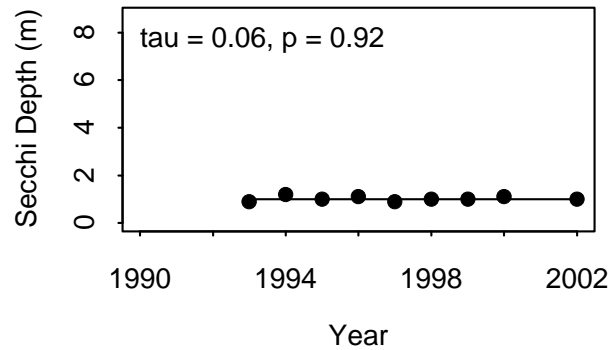
DATA SOURCES

In addition to data from Snohomish County SWM staff and citizen volunteers, data for Meadow Lake are also available from: Sumioka and Dion, 1985. Please refer to the full list of references in the County-Wide Summary.

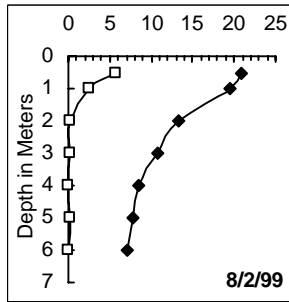
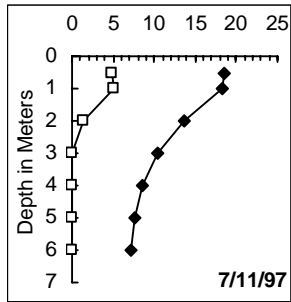
WATER CLARITY



TREND ANALYSIS



DISSOLVED OXYGEN AND TEMPERATURE PROFILES (SELECTED YEARS)



—□— DO (mg/l) —◆— Temp (°C)

BASIC MONITORING DATA

1995									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
5/30/1995	1.2	27.5	24.5	6.25	0	none	breezy	lt brown	Slight algae, scum. Heavy plant growth in wetlands & to 1' depth. 1 adult mallard w/ 8 juveniles. Regularly see mallards, wood ducks, buffleheads, & geese. Visited by cormorants, osprey, hooded mergansers, bald eagle.
6/25/1995	1.1	27.5	22	5.75	0	none	light	lt brown	Heavy plants near shore.
8/13/1995	1.0	24.5	20	5.5	10	moderate	light	lt brown	Slight algae, scum, heavy aquatic plants. Lily pads died prematurely. Explosive growth of frog's bit around wetland. Leafless, branchy plant growing at 3 -4 ft depth.
9/22/1995	0.9	25	19	7.5	25	none	breezy	lt brown	Slight-moderate algae & scum, moderate-heavy aquatic plants to 1-2 ft from shore. Approx 8 - 10 ducks at dusk, they aren't here during the day. Lot's of bullfrog egg sacks.
10/29/1995	1.0	15	10	3.5	10	none	calm	lt brown	9 ducks/geese. Slight algae, scum. Moderate plants at lake edge.

1996									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
5/26/1996	1.4	13	17	2	25	none	light	lt brown	Slight algae, scum, heavy plants, no odor.
7/7/1996	1.1	24	24	5	0	none	calm	lt brown	No odor, slight algae, scum, heavy plants at edge. 1 osprey.
8/22/1996	1.0	25.5	22	8.25	0	none	light	lt brown	
10/6/1996	1.1	20	15	4.25	10	moderate	calm	lt brown	

1997									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
*07/11/97	1.1				90	mod	light	dk brown	Lake surrounded by wetland. Narrow band of plants along shore; nuphar dominant, some ribbon-leaf p.w., narrow leaf p.w., duckweed, Hydrocharis morsus-ranae.
7/13/1997	0.8	25.5	24	2.75	75	none	light	lt brown	Heavy plants near shore, slight algae.
8/23/1997	0.9	21	24	8	0	trace	light	lt brown	Slight algae, scum. heavy plants near shore. 1 osprey with fish, 2 ducks.

*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
7/16/1998	1.1	31.5		7	0	moderate	breezy	lt brown	Slight algae and scum; heavy plants; no odor; 1 osprey; 1 king fisher; 1 heron.
8/18/1998	1.0	17	19.5	11	100	trace	light	lt brown	Slight algae & scum; heavy plants at edge; no odor; no ducks/geese.
8/26/1998	1.2	24	21	11.5	25	none	calm	lt brown	Slight algae & scum; heavy plants at edge; no odor; 3 ducks; 1 king fisher; 1 heron; 1 American bittern
9/20/1998	0.9	22	19	13.5	10	light	calm	lt brown	No algae, scum, or odor. Heavy aquatic plants near shore. 10 ducks/geese.

1999									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
7/23/1999	0.9	22	22	3	0	none	light	lt brown	Sent plant sample for ID (Potamogeton sp.).
*8/2/99	1.1	25.5	21		0	none	calm	dk brown	Moderate odor from bottom sample.
9/12/1999	1	26	18	6	0	none	light	lt brown	

2000									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
4/24/2000		12	14	24	90	moderate	calm	lt green	No ducks, algae, or algae scum, and heavy aquatic plants.
6/17/2000	1.1	24.5	20	2.75	10	moderate	calm	lt brown	No ducks, algae, or algae scum, and slight aquatic plants.
7/15/2000	1.1	25	20	16.3	0	none	breezy	lt green	2 ducks, moderate algae and algae scum, and heavy aquatic plants.
8/7/2000	1.1	27	23.5	8.5	0	none	light	lt brown	Slight algae and algae scum.

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

HOW YOU CAN HELP MEADOW 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 Meadow Lake.

(TTY users call 425-388-3700)