

LAKE HOWARD

REPORT DESCRIPTION

This report is an annual update to the 2003 State of the Lakes Report and includes water quality data collected from 2003 through 2009. For additional background on the information provided here or to find out more about Lake Howard visit www.lakes.surfacewater.info or call Snohomish County Surface Water Management (SWM) at 425-388-3464.

LAKE DESCRIPTION

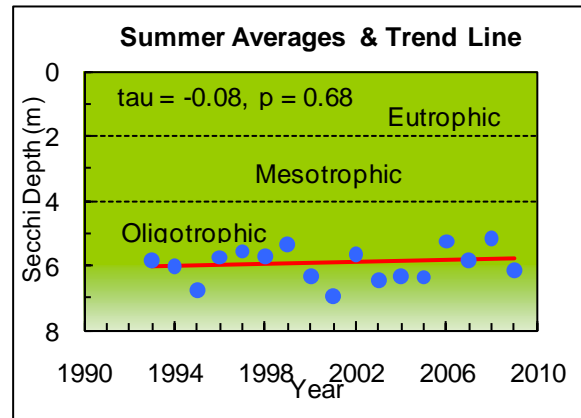
Lake Howard is a 28 acre lake located in the Seven Lakes area north of the Tulalip Reservation. The lake is relatively deep, with a maximum depth of 15.2 meters (50 feet) and an average depth of 8.8 meters. The lake is situated in a protected bowl surrounded by wooded hills. Much of the watershed is undeveloped, but growth is occurring in the area and may begin to affect the lake.

LAKE CONDITIONS

The following graphs illustrate the summer averages and trend lines (in red) for water clarity, total phosphorus, and chlorophyll for Lake Howard. Please refer to the table at the end of the report for long-term averages and for averages and ranges for individual years.

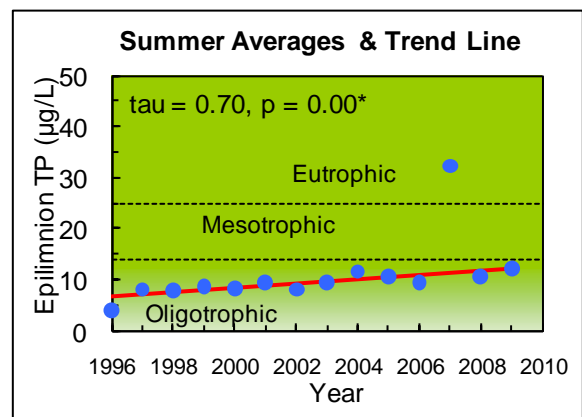
Water Clarity

Water clarity is generally high at Lake Howard, with a 1993 – 2009 long-term summer average of 6.0 meters. Water clarity averages vary considerably from year to year, possibly because of the high variability of the nutrient levels in the bottom waters. However, no significant trends of increasing or decreasing water clarity are apparent over the long term.



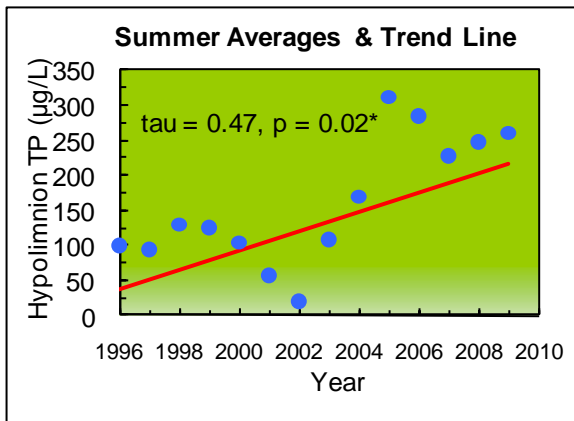
Total Phosphorus (key nutrient for algae)

Total phosphorus concentrations in the epilimnion (upper waters) are low, with a 1996 – 2009 long-term average of 11 µg/l. However, in 2007 the summer average was 32 µg/l, three times the long-term average. Also, there has been a gradual, and statistically significant, trend toward higher phosphorus concentrations in the upper waters of Lake Howard. Summer averages are still in the oligotrophic range but are rising toward the mesotrophic range (the lower threshold value of mesotrophic is 14 µg/l). Higher phosphorus levels will likely result in more nuisance algae in the lake.



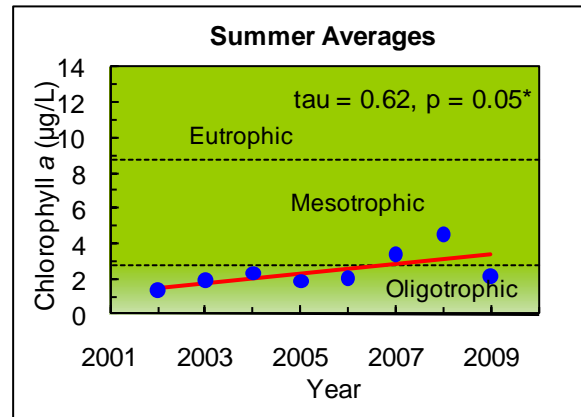
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The summertime phosphorus averages in the hypolimnion (bottom waters) are much higher and quite variable. The 1996 – 2009 long-term average is 160 µg/l. Although there were very low phosphorus values in 2001 and 2002, the averages have steadily increased since then, reaching a maximum of 312 µg/l in 2005. Over the entire period, there has been a statistically significant increasing trend in phosphorus concentrations in the bottom waters. This build-up of phosphorus in the bottom of the lake, coupled with the rising phosphorus levels in the upper waters, is an indicator of accelerating eutrophication and a warning of poorer water quality in the future.



Chlorophyll a (Algae)

Chlorophyll a values show low to moderate levels of algae in the summers of 2002 - 2009. The long-term summer average over the seven years is 2.4 µg/l. The 2008 chlorophyll a average of 4.5 µg/l was the highest on record. Between 2002 and 2009 there has been a statistically significant trend toward increasing chlorophyll a (algae) levels. There are also often high dissolved oxygen and pH levels several meters below the surface of the lake, which likely indicate algal growth at that depth. The chlorophyll a samples, which are taken at 1 meter deep, may be missing this zone of algal growth, so in actuality the algae levels may be even higher than shown by the chlorophyll a measurements. The lake does experience algal blooms from time to time, particularly in the spring and early summer.



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SHORELINE CONDITION

The condition of the Lake Howard's shoreline was surveyed in 2008 (see map on page 4). The lake shoreline condition is important for understanding the overall lake health. Frequently, lake shorelines are modified either through removal of natural vegetation and/or the installation of bulkheads or other hardening structures. This type of alteration can be harmful to the lake ecosystem as natural shorelines protect the lake from harmful pollution, prevent bank erosion, and provide important habitat for fish and wildlife.

Lake Howard has a moderately developed shoreline. Surveys conducted in the mid-90s showed 32 homes bordered the lake. Although homes were not counted in 2008, 35 docks were present covering a quarter of an acre of the lake surface. Armoring of the shoreline was found along 28% of the 0.9 mile long shoreline. Most of the armoring is rock or log revetments (20% of the shoreline) in addition to a small number of bulkheads. The natural vegetation immediately adjacent to the shoreline has been significantly altered, with only 41% of the shoreline still supporting native grasses, shrubs, or trees. There is still a moderate amount of large wood (about 51 pieces) remaining in the lake. These old logs and branches are valuable for fish and wildlife habitat.

The overall amount of shoreline modification leaves the lake susceptible to pollution from the watershed, eliminates the buffer of native vegetation that can filter out pollution, and limits the amount of habitat available for fish and wildlife.

SUMMARY

Trophic State

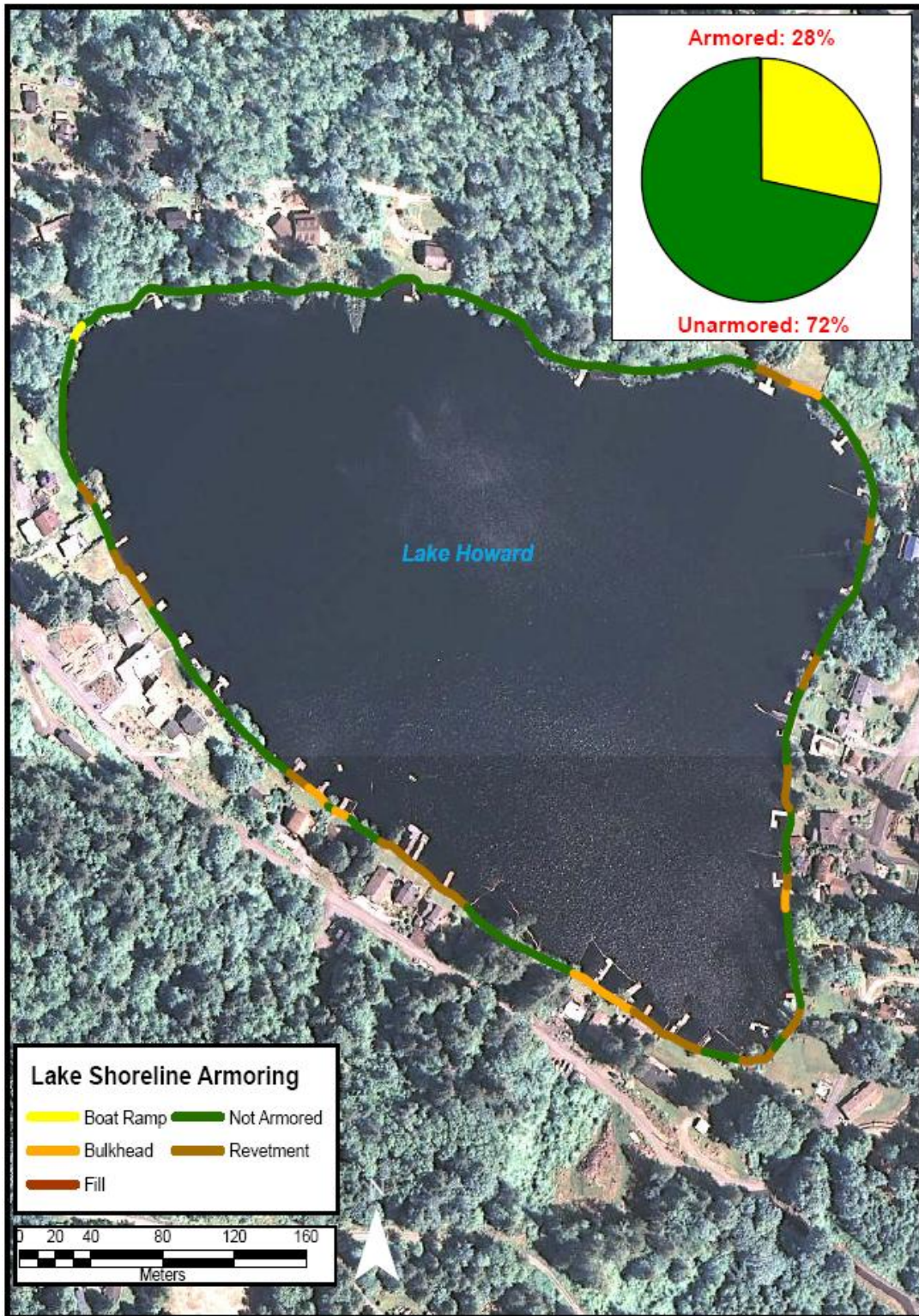
In spite of high water clarity and low phosphorus in the epilimnion, Lake Howard may be classified as mesotrophic based on elevated phosphorus in bottom waters, low to moderate algae levels, low dissolved oxygen in the bottom waters, and moderate levels of aquatic plants.

Condition and Trends

With a long-term water clarity average of 6.0 meters, Lake Howard is meeting the water clarity target set forth in the 2003 State of the Lakes Report of maintaining stable water clarity. However, the lake is not meeting the target of reducing hypolimnetic phosphorus to less than 90 µg/l that was set forth in the State of the Lakes Report. In fact, the hypolimnetic concentrations are becoming increasingly worse with the long term average now at 160 µg/l. The upper waters are also experiencing increasing phosphorus levels, and chlorophyll a levels are increasing.

Overall, Lake Howard appears to be at risk for future water quality declines. The increasing phosphorus in the upper and lower waters combined with periodic algal blooms and increasing chlorophyll a levels are warning signs that accelerated eutrophication is occurring in the lake. The primary threat to Lake Howard is the inflow of nutrients into the lake through human activities and new development in the watershed. Nutrients enter the lake through stormwater runoff from the watershed. Sources of nutrients include fertilizers, pet wastes, and erosion from construction or land clearing. Nutrients may also directly enter the lake through poorly maintained septic systems. Measures to control nutrients in the watershed should be taken now to reverse the trends of increasing phosphorus and prevent any future negative impacts to the lake. To find out more about ways to protect lake water quality and information on the causes and problems of elevated lake nutrient levels visit www.lakes.surfacewater.info.

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DATA SUMMARY FOR LAKE HOWARD					
Source	Date	Water Clarity (Secchi depth in meters)	Total Phosphorus (ug/l)		Chlorophyll a (ug/l)
			Surface	Bottom	Epilimnion
McConnell, et al, 1976	Summer 1973	2.3 - 2.7 (2.5) n = 3	14 - 60 (32) n = 3	110 - 190 (150) n = 3	1.8 - 2.0 (1.9) n = 3
Sumioka and Dion, 1985	6/30/1981	6.4	20	310	2.3
Entranco, 1986	1983	3.8 - 5.0 (4.5) n = 5	<5 - 17 (10) n = 5	70 - 359 (157) n = 5	1.0 - 9.9 (3.9) n = 5
DOE	1993	5.0 - 7.3 (5.8) n = 12	-	-	-
SWM Staff or DOE	1994	5.3 - 6.9 (6.0) n = 7	-	-	0.1 - 3.2 (1.7) n = 4
SWM Staff	1995	6.8	-	-	2.4
SWM Staff or Volunteer	1996	4.6 - 6.8 (5.8) n = 6	3 - 5 (4) n = 2	76 - 122 (99) n = 2	-
SWM Staff or Volunteer	1997	5.1 - 6.1 (5.6) n = 2	5 - 11 (8) n = 2	82 - 106 (94) n = 2	-
SWM Staff or Volunteer	1998	4.0 - 6.9 (5.7) n = 10	6 - 10 (8) n = 4	89 - 150 (129) n = 4	-
SWM Staff or Volunteer	1999	3.7 - 7.4 (5.4) n = 12	7 - 10 (9) n = 4	74 - 150 (126) n = 4	-
SWM Staff or Volunteer	2000	5.1 - 7.3 (6.3) n = 7	3 - 11 (8) n = 4	58 - 175 (104) n = 4	-
Volunteer	2001	6.0 - 8.0 (6.9) n = 5	7 - 13 (9) n = 4	27 - 88 (57) n = 4	-
SWM Staff or Volunteer	2002	3.7 - 7.3 (5.7) n = 8	7 - 9 (8) n = 4	9 - 30 (21) n = 4	0.8 - 2.1 (1.3) n = 4
SWM Staff	2003	5.7 - 7.1 (6.5) n = 4	8 - 11 (9) n = 4	46 - 188 (107) n = 4	0.8 - 2.7 (1.9) n = 4
SWM Staff	2004	5.4 - 7.5 (6.3) n = 4	9 - 15 (12) n = 4	61 - 270 (170) n = 4	1.1 - 3.7 (2.3) n = 4
SWM Staff	2005	5.5 - 7.6 (6.4) n = 4	8 - 13 (11) n = 4	256 - 350 (312) n = 4	1.6 - 2.0 (1.9) n = 4

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			Surface	Bottom	Epilimnion
SWM Staff or Volunteer	2006	4.4 - 7.0 (5.3) <i>n</i> = 7	6 - 13 (9) <i>n</i> = 4	222 - 360 (285) <i>n</i> = 4	1.6 - 2.9 (2.0) <i>n</i> = 4
SWM Staff or Volunteer	2007	5.1 - 6.7 (5.9) <i>n</i> = 6	11 - 55 (32) <i>n</i> = 4	160 - 314 (228) <i>n</i> = 4	2.1 - 5.3 (3.4) <i>n</i> = 4
SWM Staff or Volunteer	2008	3.9 - 6.1 (5.2) <i>n</i> = 10	9 - 12 (11) <i>n</i> = 3	174 - 372 (248) <i>n</i> = 3	1.6 - 10 (4.5) <i>n</i> = 3
SWM Staff or Volunteer	2009	4.5 - 7.4 (6.2) <i>n</i> = 11	11 - 14 (12) <i>n</i> = 4	146 - 462 (261) <i>n</i> = 4	1.9 - 2.4 (2.1) <i>n</i> = 4
Long Term Avg		6.0 (1993-2009)	11 (1996-2009)	160 (1996-2009)	2.4 (2002-2009)
TRENDS		None	Increasing	Increasing	Increasing

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
- "Surface" samples are from 1 meter depth and "bottom" samples are from 1-2 meters above the bottom.